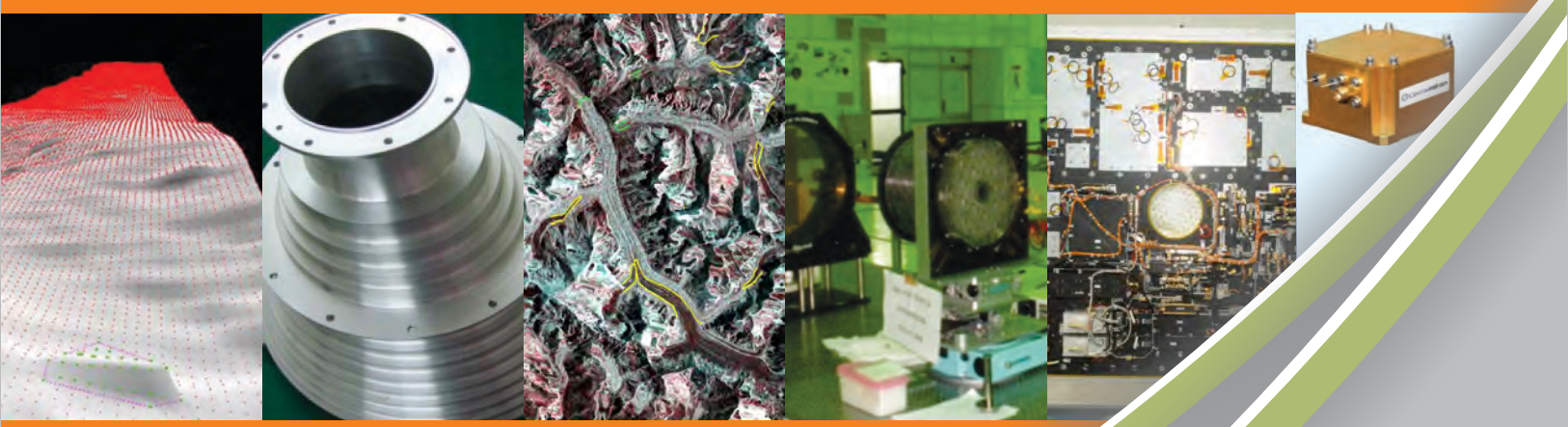
ANNUAL REPORT
2012 - 2013



SPACE APPLICATIONS CENTRE
INDIAN SPACE RESEARCH ORGANISATION,
AHMEDABAD - 380 015.

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Director's Preface

During this year there have been some significant activities towards the space based Navigation systems & applications. With launch and operationalisation of GSAT-10 with GAGAN payload, operational requirement of Satellite-Based Augmentation System (SBAS) was achieved. During the year, SAC has delivered a state of the art Navigation payload consisting of Navigation Signal Generator Unit, Innovative Dual Band Helical Antenna and Atomic Clock, for IRNSS -1A & 1B. To complete the constellation in a short period, SAC has geared up with Indian industries. It is envisaged that majority of the subsystems of Navigation payloads will be fabricated and tested at Industry.

In addition to this, towards SATCOM activities; payloads of GSAT-9, GSAT-15 & GSAT-16 are in the advanced stage of realisation. Most of their subsystems have been realized and payloads are expected to be delivered as per the desired schedules of the missions. Payload development for GSAT-11 and GSAT-7A is in advanced stage. Various critical technologies have been realized during the year.

SAC team has been working towards the inter-planetary "Mars Orbiter Mission". SAC has developed three key Electro-optical Payloads; Methane Sensor for Mars (MSM), Thermal Infrared Imaging Spectrometer (TIS), and Mars Colour Camera (MCC). Related Data Products software is getting developed at SAC. SAC is also working towards the delivery of the HSP instruments for Monitoring of Oxygen, Carbon dioxide, Temperature, Relative Humidity and Cabin Lighting & Control System.

In the area of Remote Sensing, Resourcesat-2A payload realisation work is progressing well. All Payload subsystems' realisation is as per the schedule. LISS-3* is expected to be delivered in December 2013. Work on INSAT 3DR & INSAT 3DS is in advanced stage. INSAT 3DR imager is scheduled to be delivered in December 2013. Various technology development works for GISAT 1 & 2, Carto Series and Oceansat Series have been achieved during the year. Payload subsystems for these satellites are getting fabricated and are soon expected to reach payload integration stage.

RISAT-1 with C Band SAR is successfully operating for the last one and a half year. All planned modes were exercised successfully viz,. Stripmap (3 m res.), ScanSAR (115 km, 220 km swath) and Spotlight (1 m res.). Circular polarimetry with all these modes was performed. Design & Development for future Radar Payloads of RISAT-1A & RISAT-3(L Band) are progressing well. Various technologically challenging works towards realizing these payloads have been initiated. Air-borne C-Band FM DMSAR was delivered for integration with aircraft at NRSC. X-band DMSAR Design Verification Model was realised.

SAC, being the lead centre for the space based applications, has done commendable work during the year. In Agriculture applications area, FASALSOFT [indigenously developed by SAC and installed at Mahalanobis National Crop Forecast Centre (MNCFC), Delhi] is playing a key role. It has been upgraded with RISAT-1 MRS data modules. Under National Food Security Mission various tasks like Wheat Rust Disease prediction, Pulse Intensification estimation & support to Bringing Green Revolution to Eastern India (BGREI) program have been carried out.

In Weather Monitoring & Forecasting activities, MOSDAC is performing an important role. A new version of MOSDAC website has been released. Prediction model related activities have been executed during the year. Some of them are Assimilation of SAPHIR radiances & AMV winds in NWP models, Assimilation of NDVI, Land Surface Temperature (LST), Insolation in NWP model and Now-casting of heavy rainfall events. In Cyclone detection and prediction, range prediction has been extended (15-day ahead) for Cyclogenesis. GIS based cyclone analysis system & SCORPIO web portal have been developed. Extensive activities have been carried out in the areas of Polar Science studies, ocean science, and Environment & Climate Change studies.

Keeping in view the missions to be realized in the 12th FYP and beyond, SAC has continued its facility augmentation activities. Some of the new facilities established are Pin-less registration system for multi-layer PCB, 3D CT X-ray Inspection system with 4 μm resolutions, Automatic Optical Inspection, EB Lithography tool with 100nm capability. Low Temperature Co-fire Ceramic (LTCC) Facility is being established for the miniaturisation of packaging for Microwave, mm-Wave and Cooled EO detectors.

SAC gives major focus on R&D and Technology development work. Currently, in the Centre, more than 175 Technology development activities are at various stages of progress in four disciplines of RF & Optical, Electronics, Applications and Processes.

During the year, a significant work has been carried out for the development of Indigenised Atomic Clock for the Navigation payloads and other components & processes.

The RESPOND programme has been running at SAC with the continuous research support of academic institutes and universities located in different states of India. Currently 41 research projects are going on under RESPOND program at SAC.

It has been a very exciting year for the SAC; Centre has strived and performed in all areas of its activities.

A. S. Kiran Kumar

SAC Management Council (SMC) As on March 31, 2013

Shri. A. S. Kiran Kumar, Director, SAC & Chairman, SMC

Shri.V. S. Palsule, Director, DECU

Shri. D B Bhatt, Controller, SAC

Shri.D. K. Das, DD, SNPA

Dr. J. S. Parihar, DD, EPSA

Shri.Santanu Chowdhury, DD, SIPA

Shri. D R M Samudraiah, DD, SEDA

Shri.Tapan Misra, DD, MRSA

Shri. R. K. Arora, DD, ESSA

Shri.R. K. Dave, DD, SRA

Shri. D. Subrahmanyam, DD, MESA

Shri. K. S. Parikh, DD, SNAA

Shri. D B Bhatt, GD, PPG & Member Secretaray, SMC

SAC ORGANISATION

As on March 31, 2013

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SPACE APPLICATIONS CENTRE

Space Applications Centre (SAC) is a unique centre dealing with a wide variety of themes from payload developments to societal applications, thereby creating a synergy of technology, science and societal applications. The centre is responsible for the development, realization and qualification of communication, navigation, earth observation and planetary payloads and related data processing and ground systems in the areas of communications, broadcasting, remote sensing, disaster monitoring/ mitigation, etc. It is playing an important role in harnessing space technologies for a wide variety of applications for societal benefits. In order to carry out the above tasks, SAC has highly sophisticated payload integration laboratories, electronic and mechanical fabrication facilities, environmental test facilities, systems reliability/assurance group, image processing and analysis facilities, project management support group and a well-stocked library. SAC has also put adequate emphasis on and practicing outsourcing and indigenous development of technology and vendors.

Activities at SAC are organized into following Areas; SATCOM and Navigation Payload Area (SNPA)

- SATCOM and Navigation Applications Area (SNAA)
- Sensor Development Area (SEDA)
- Microwave Remote Sensors Area (MRSA)
- Signal and Image Processing Area (SIPA)
- Earth, Ocean, Atmosphere, Planetary Sciences and Applications Area (EPSA)
- Electronic Support Service Area (ESSA)
- Mechanical Engineering Systems Area (MESA)
- Systems Reliability Area (SRA)
- Antenna Systems Group (ASG)
- Planning and Projects Group (PPG)
- Library
- Administration & Auxiliaray services

These areas are working closely for the realisation of the Communication, Navigation, Remote Sensing and Science/Planaetary payloads and development of innovative space applications for the societial benefits. Brief description about each Area/entity and its functional details is given in the following sections:

SATCOM and Navigation Payload Area (SNPA)

SNPA is responsible for delivering the payloads for all spacecrafts providing communications and navigational services, most notably the GEOSAT and IRNSS programs. Different specialist teams work together to design these payloads, to develop the various subsystems, and finally integrate and test the payloads.

The overall management of communication & navigation payload design, development and delivery for all GEOSAT projects vests with SNPA.

The payload architectures are constantly evolving in capacity and functionality. The INSAT series and the first generation GSAT spacecraft carried workhorse transponders for applications such as DTH broadcasting, VSAT connectivity, mobile satellite services, tele-medicine, tele-education and a host of other applications.

At the other end of the scale are advanced payloads such as GSAT-7, developed for Special Users and GSAT-11, which will provide broadband network connectivity to home, enterprise and community level users. SNPA also designs transponders & data transmitters for applications like for Data Relay Transmission, Satellite Aided Search & Rescue, Met. Data transmitters. The development of payloads for Geo-based Advanced Imaging Satellite (GISAT) is a current example of this application class.

SNPA has established a range of State-of-the-Art facilities that are at par with those found anywhere in the world. This enables SNPA to apply the latest and most appropriate techniques right from the design stage up to test, characterization, integration and final checkout.

SATCOM and Navigation Applications Area (SNAA)

SNAA is responsible for development & implementation of various new technologies pertaining SATCOM and Navigation Applications. SNAA is responsible for the design and development of fixed and portable satellite communication terminals at different frequency bands and the technology development in association with Antenna Systems Area and SATCOM and Navigation Payloads Area to provide total systems solution.

SNAA is responsible for technology development activities related to fixed and mobile satellite communication services and wide-band networks for carrying video and data for educational applications. SNAA is involved in development of multimedia terminal for GSAT-6 and UHF receiver for GSAT-7. It is also responsible for design & development of User Receivers, Encryption scheme and code analysis for Indian Regional Navigation Satellite System (IRNSS).

SNAA is responsible for conducting SATCOM experiments, maintenance, augmentation and operations of Delhi Earth Station, Ahmedabad Earth Station and associated facilities. It is also responsible for conducting SATCOM experiments related to disaster management and societal applications.

Sensor Development Area (SEDA)

Sensors Development Area is responsible for the design, developement, assembly, testing and operationalization of electro-optical payloads for remote sensing, meteorological and planetary missions. SEDA is involved from the conceptual design stage to hardware realization, characterization, integration with spacecraft and launch-site and in-orbit tests after launch.

In the last two decades SEDA has designed, developed and flown more than 50 state-of-the-art spaceborne payloads, which have not only served the country but also won laurels across the globe with their unique application oriented design and imaging capabilities. They have provided scientific data in every field of remote sensing, including thematic mapping, oceanography, atmospheric science, cartography etc. SEDA has also developed many airborne instruments for aerial surveys. SEDA has the state-of-the-art facilities which include clean rooms, laboratories, test facilities, T&M instruments etc.

Microwave Remote Sensors Area (MRSA)

MRSA has been actively involved in enhancing the capabilities of ISRO's Earth Observation (EO) missions by augmenting and complementing operational optical sensors with the state-of-the-art microwave sensors. In recent years, microwave sensors related operational activities have gained momentum with the successful launch of Oceansat-2 Scatterometer, Megha Tropiques MADRAS, Airborne SAR for Disaster Management (DMSAR) and RISAT-1 C-Band SAR. Thus, the journey which had started with development activities related to MSMR Payload onboard Oceansat-1 (1996-1999) and C-band Airborne SAR (ASAR) test & calibration flights (2001-2005) had come to ages with RISAT-1 launch.

Major advanced technology development activities for various Microwave sensors for ISRO's future Earth Observation programmes like Mm Wave Temperature Sounder (Scatsat-1 /Oceansat-3), L-band Spaceborne SAR (RISAT-3) and X-Band spaceborne SAR (RISAT-4) are being carried out at MRSA.

MRSA is also providing considerable support for sensor related post-launch radar data/signal processing, calibration and other ground segment activities for RISAT-1 SAR, Oceansat-2 Scatterometer and Megha Tropiques MADRAS payloads. MRSA has also developed a dual channel C-band Active Radar Calibration (ARC) for RISAT-1 SAR sensor and is in the process of developing Ground Based C-Band Scatterometer for RISAT-1 SAR

Signal and Image Processing Area (SIPA)

Signal and Image Processing Area (SIPA) is involved primarily in the design, development, operationalisation and maintenance of softwares for remote sensing data processing related to earth, planetary and astronomical observations for Indian as well international user community. SIPA is also involved in design & development of custom-made software for specific ISRO/Antrix clients in this domain.

SIPA is responsible for design of software-intensive systems and core algorithms related to data & information products generation and data quality evaluation of remotely sensed data using signal processing, image processing & photogrammetric techniques.

SIPA performs simulations and modelling of data products and processing algorithms in advance of mission operations for user sensitisation/ software development. It is also involved in development, Installation,

Training and Maintenance of operational software-intensive systems of international standard for data and information products generation and data quality evaluation.

SIPA develops facilities to provide support for data products generation operations at different world-wide installations for Indian optical and microwave remote sensing satellites for Indian and International ground stations in liaison with other ISRO/DOS centres, particularly from ISAC, ISTRAC & NRSC.

SIPA also develops operational facilities to generate efficient & qualified software for data products & information products generation using software engineering techniques on target computer architectures.

Earth, Ocean, Atmosphere, Planetary Sciences and Applications Area (EPSA)

EPSA is responsible for all activities related to understanding Earth System, its components, processes and interactions using earth observation data, and its applications towards societal benefits. EPSA also carries out space data analysis for planetary sciences.

The area focuses on retrieval of geophysical parameters, data assimilation, improved weather and ocean state forecasts, polar ice studies, studying impact of climate change and sensor system definition studies, etc. EPSA carries studies related to marine biological system, ocean colour, ocean bio-geo chemistry, coastal processes, geo hazards, lithosphere, cryosphere, etc. EPSA is also responsible for all cal-val activities and analysis of space data for planetary sciences. EPSA also works on developing improved techniques for crop assessment and forecasting, assessment and modeling of terrestrial biosphere, study impact of climate change and modeling hydrology cycle, etc. EPSA works on various aspects of urban and regional planning using RS and GIS techniques. It is also responsible for organizing/maintaining various data bases, map libraries, data products repository, near real time dissemination systems, and web-based software development for database applications. EPSA is engaged in development of advanced techniques for handling data from newer sensors, their analysis, simulation and modeling, etc.

Electronic Support Service Area (ESSA)

ESSA is responsible for carrying out all electronics engineering related support services including operations/maintenance of related fabrications and test facilities. ESSA carries out formulation of design concepts, actual design, fabrication and characterisation of sub-systems for various communications, navigation and earth observation payloads. ESSA also provide technical expertise, in related fields, for development of indigenous sources. ESSA comprises of the state of the art facilities like Environmental test (EnTF), Electronic fabrication and test (EFTF), Micro electronic facility (MEF), these facilities provide round the clock support to the ongoing projects and R&D works in the centre.

Mechanical Engineering Systems Area (MESA)

Mechanical engineering activities at the Centre comprise design, development, realization, testing and delivery of mechanical components and systems for communication, remote sensing and navigational payloads, various ground antennas and other ground optical system projects. MESA is responsible for structural and thermal analysis of payload systems and sub-systems. MESA is also responsible for operations of Vibration Test Facility (VTF), which conducts the dynamic tests. MESA also carries out quality control and metrology of mechanical components for space & ground/R & D projects. It provides QC support to the mechanical components fabricated in-house as well as through external vendors.

Systems Reliability Area (SRA)

SRA carries out Reliability Engineering functions for various Space and Ground hardware developed in the centre. These encompass Quality Assurance in Electronics & Mechanical Engineering and processes, Electro-chemical Materials & processes and Test & Evaluation activities. Software Quality Assurance activities are also carried out in SRA. The prime activity of SRA is the formulation of Quality Systems, procedures and guidelines and ensuring their compliance, for the realization of highly reliable systems, for satellite payloads for Communication, Optical & Microwave Remote sensing, Science & Planetaray as well as ground based systems.

Antenna Systems Group (ASG)

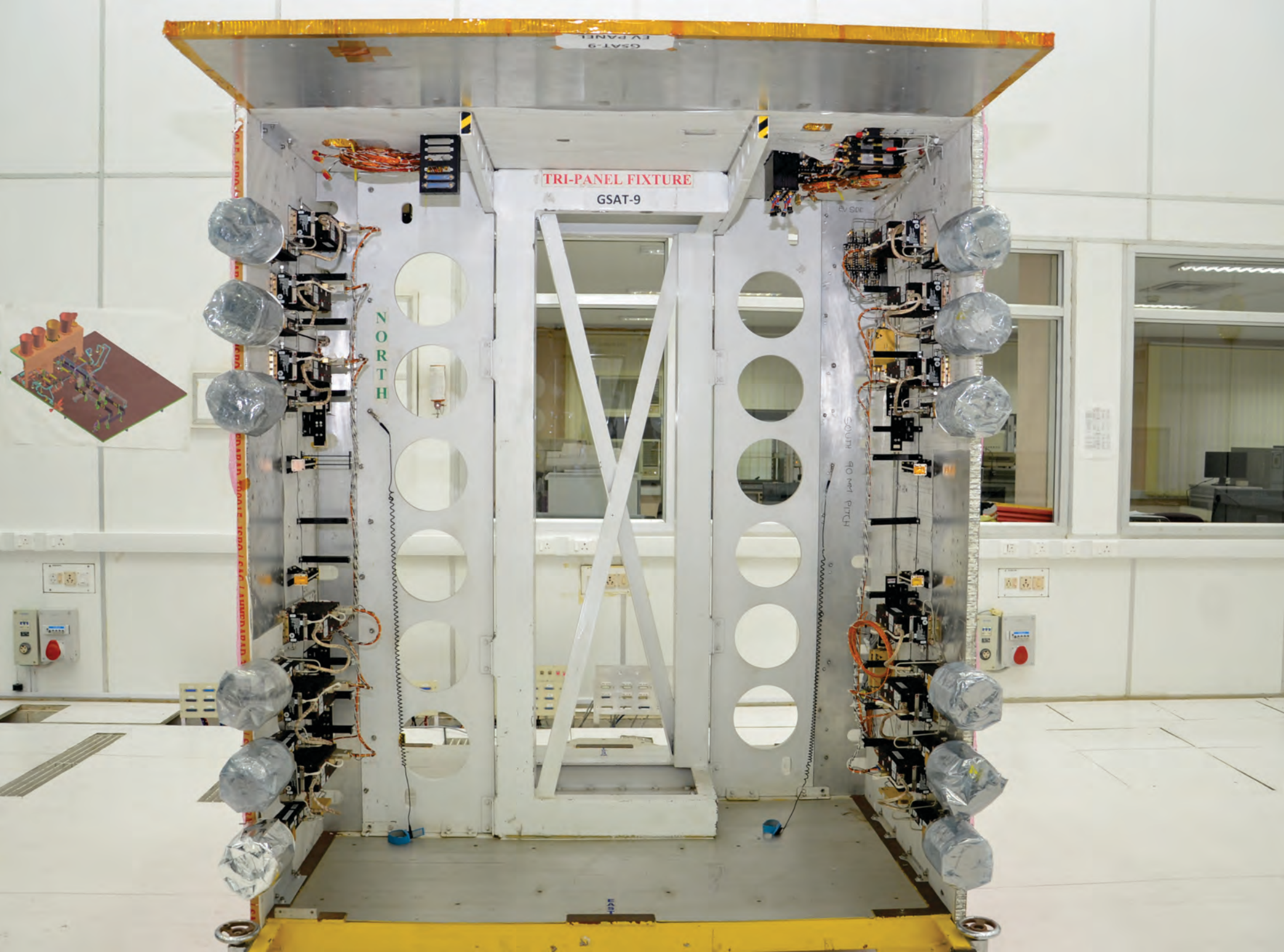
ASG is responsible for design, development, analysis and realisation of antenna systems for communication payloads as well as earth observation payloads.ASG is also responsible for design and development of antennas for Airbone as well as earth stations for remote sensing and communications. ASG continuously strives for the new R & D in the field of Antenna technology.

Planning and Projects Group (PPG)

Planning and Projects Group (PPG) plays a key role for a planned and systematic progress, growth and culmination of various projects and activities of the Centre with contribution and cooperation from all stake holders. PPG is responsible for wide variety of activities including project planning and evaluation, budget planning and expenditure monitoring, manpower planning, international cooperation, technology transfer and industrial interface, Research coordination and evaluation, human resources development, management information, providing inputs to Director SAC on several policy related matters, centralized intra and inter network planning/monitoring, etc.

Administrative and Auxiliary Services

Administrative and auxiliary service divisions provide for logistic and administrative support to technical functions. It is responsible for Personnel and General Administration, Accounts , Purchase & Stores, transport, catering, guest house, Estate Management, Horticulture etc. Construction & Maintenance Division (CMD) is responsible for construction and maintenance services.


TRI-PANEL FIXTURE
GSAT-9
NORTH
SOUTH

Communications and Navigation Satellite Payload Development Activities & Applications

Successful Operationalisation and In orbit Testing (IOT) of communication payloads for GSAT-10 & GAGAN and delivery of payloads for GSAT-14, IRNSS-1A and IRNSS-1B are the major achievements during the year.

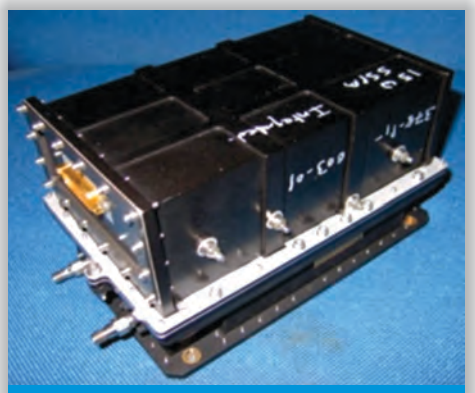
Communication payloads for GSAT-9, GSAT-16 and Navigation payloads for IRNSS-1C is planned to be delivered in next one year.

Subsystem development of GSAT-6A, GSAT-7A, GSAT-11, GSAT-15, GSAT-18, GSAT-19, GSAT-20 and Navigation payloads for IRNSS-1D to -1G are in progress.

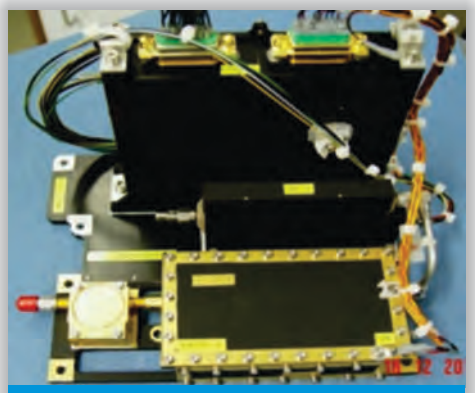
GSAT-7

GSAT-7 is the first Indian satellite with High power UHF transponders. It has wide applications in MSS, UHF, C-band and Ku-band services.

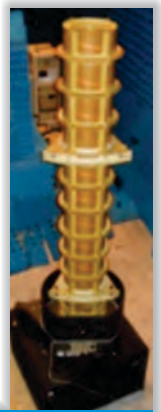
During the year various spacecraft level test were performed and payload performance was found satisfactory. C/S Reflector Antenna and UHF-Rx Patch Array Antenna were delivered to ISAC. UHF-band Transmit Helix antenna delivered to ISAC for Integration with spacecraft. In GSAT-7 satellite payload 138 out of total 150 subsystems were developed indigenously.



100-Watt UHF SSPA



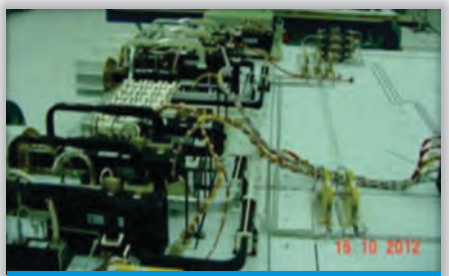
15-W Normal C-band SSPA



3m deployable Helix Antenna

GSAT-9

GSAT-9 is a high power communication spacecraft configured using I2K bus and payload consists of high power Ku-band transponders and Ku-band beacon to cater the need of increased demand from user community for Ku-band transponders for DTH service. The Ku-band payload has 2.2mx2m offset single shell shaped deployable Tx/Tx



GSAT-9: Integrated Payload

7 Chnl Ku OMUX

Ku-Beacon Source

Reflector antenna and 1.4 m dia. offset single shell shaped deployable Rx/Rx Reflector antenna to provide service over India mainland and Andaman and Nicobar Island from location 48°E longitude in dual linear polarization.

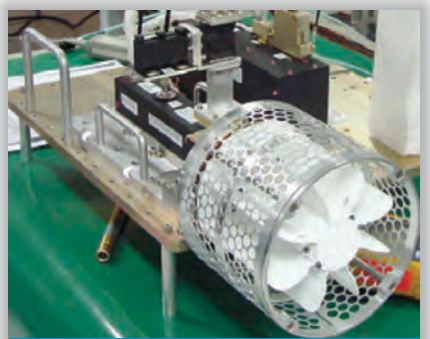
During the year, a major milestone of payload CDR was completed in June 2012. T&E of Ku-Band Receiver (FM), Ku-Band 7-Ch OMUX (Ch.1 to 6 & Ch. 7 to 12 - FM), Ku-Band Tx - Coupler (2-FM) & Ku-Band LPF (2-FM) completed. Vibration test of Ku-beacon SSPA completed.Analysis of Antennas with Spacecraft Panel completed. Design of Tx feed along with feed mounting bracket of Tx-Rx antenna completed.The payload is expected to be delivered in February 2014.

GSAT-16

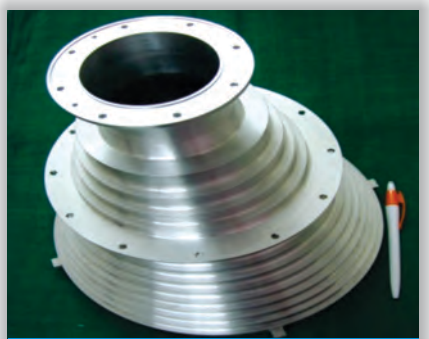
GSAT-16 communication spacecraft, configured around I-3K bus provides total 48 transponders across three bands (24 C-Nor band, 12 C-Ext band and 12 Ku band) with Beacon.

GSAT-16 is planned to be delivered in December 2013. T&E of Ku-Band Rx.- Rx. Diplexer (QM+FM), Ku-Band IMUX (Ch.1 to 6 & Ch.7 to 12), C-Band Rx- Couplers (FM), C-Band Rx. - Rx. Diplexers (FM), Nor. C-Band IMUX (Ch.1 to 11, Ch.2 to 12, Ch.13 to 23 & Ch.14 to 24), Ext. C-Band 6 Ch. OMUX (Ch. 26 to 30, Ch. 31 to 36 & Ext. C-Band 6 Ch. IMUX (Ch. 26 to 30 & Ch. 31 to 36) was completed.

Electrical assembly of Ku-beacon SSPA is under progress. Five C-band receivers delivered for Payload integration. All the feed antennas of C-band & Ku-band DGR are loaded for silver plating and black painting. Internal design review of C-band DGR antenna for Indian C Band coverage ((ICC), 3.7-4.2 GHz, 4.5-4.8 GHz) was completed and T&E Document has been prepared.



Ku Band 140W LTWTA



DGR Feed Horn

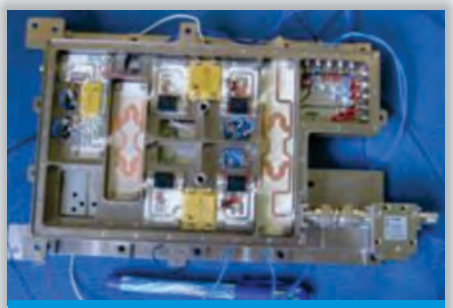
6-CH Ku Band IMUX

GSAT-15

GSAT-15 communication spacecraft, configured around I-3K bus, provides a combination of Ku-band transponders with beacon as well as GAGAN payload. The GSAT-15 communication payload will augment the Ku band transponder capacity of INSAT systems by adding 24 Ku band transponders. GSAT-15 is also having GAGAN payload which completes the operational fleet for defined service along-with 2 beacon transmitters.

Subsystems development is under progress. GAGAN Band Pass Filters (BPFs) were developed & tested. Testing and optimisation of L5 up-converter FM1 & FM2 completed. 100MHz Master Local Oscillator (LO) (2FM), 360MHz LO (2FM), 3200MHz, LO (2FM), 3300MHz LO (2FM) & 1GHz LO (4FM) of GAGAN payload are under Integrated testing.

CDR was completed on December 4, 2012. Layouts for North and South panels are finalized. T&E of Ku-Beacon SSPA completed.



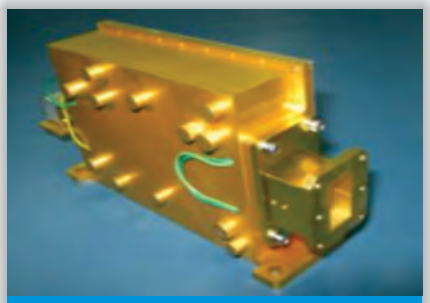
L-Band SSPA (Power Amplifier Tray)

Ku Band Beacon SSPA

Ku Band Receiver

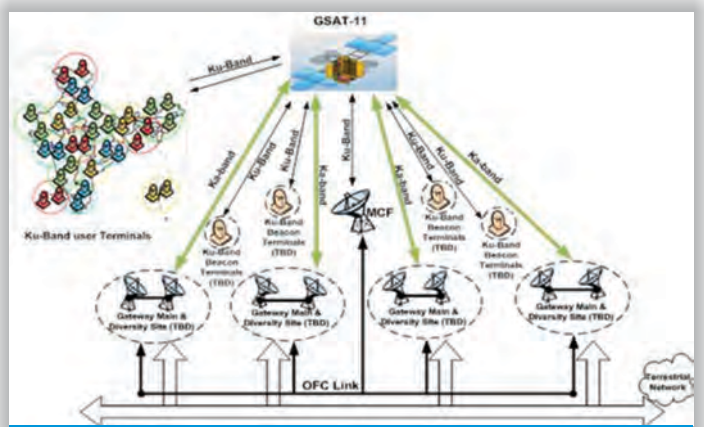
GSAT-11

GSAT-11 is the first High Throughput Satellite of ISRO. The features of payloads includes 16 spatially separated user beams in Ku-band, 4 spatially separated Hub beams in Ka-band, Ka x Ka link (125 MHz BW) across two hub beams and total throughput is approximately 10 Gbps (for FSS & Broadband).



Ku-LNA

During the year, significant work has been carried out on various subsystems. Electrical characterization for Ku-Band Tx-Rx Coupler (QM) was completed. Mechanical fabrication for Ku-Band IMUX Assembly (Lower Band QM & Upper Band PFM), Ka-Band HRF (QM+FM), Ka-Band PIM Filter (QM+FM) and Ka-Band Tx. & Rx Coupler (QM+FM) was completed. Testing of 2-beam code of DMUX and integrated testing of Channel Router card and Mesh Network Processor cards were completed. 2-Beam Transparent processor was developed & demonstrated. Detailed characterization and optimization is in progress.



Ground Segment

Design, analysis & optimization of Ka-band Tx/Rx corrugated horn antenna was carried out. RF verification & 3-D Modelling of Ka-band Tx/Rx diplexer of Ka-band gateway antenna was completed. Analysis of integrated feed system consisting horn, transition & OMT for KU Tx Tx Beacon horn completed. 20 GHz and 30 GHz (Ka-band) Tx/Rx feeds, DVM are successfully characterized at anechoic chamber.
Ground Segment is planned with Eight 9.2m Ka band Hub & four Beacon transmitters and User terminals in Ku band. EOI response for the establishment of the network for GSAT-11 ground system evaluated by industry and draft RFP is ready.

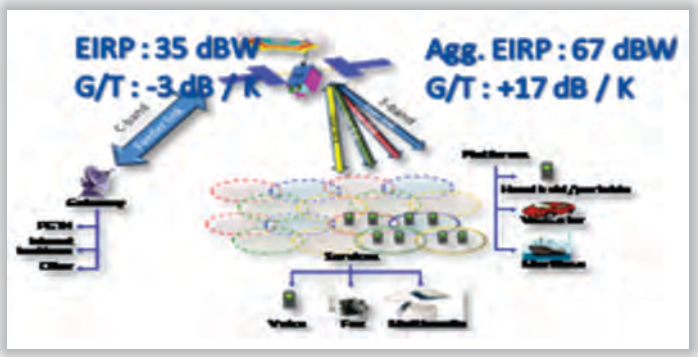
Under onboard Tracking Receiver development, PDR of Tracking system & Receiver was completed and DVM has been realized.

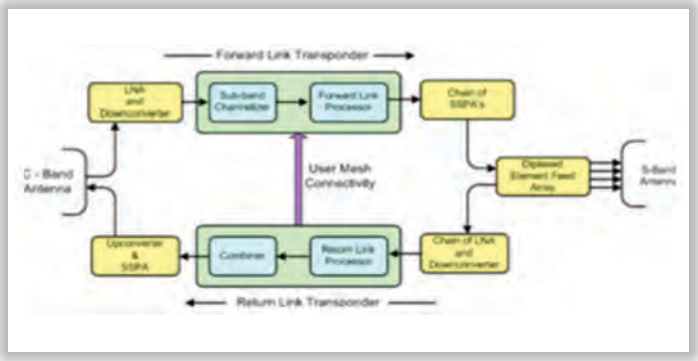
GSAT-7A

GSAT-7A payload will provide communication capability for airborne communication applications to the special user in Ku-band over Indian land mass, islands and surrounding regions. The payload will also support high data rate direct connectivity to fixed ground based communication networks within Indian mainland. Payload level CDR completed in January 2013.

GSAT-20

GSAT-20 is next-generation payload having high throughput S-band payload for Handheld MSS Applications with Spot Beam & wide beam coverage through 12m unfurlable antenna with DBFN (Digital Beam forming network). This will significantly improve the performance & capacity of mobile satellite services in the country. Payload configuration options are being worked out.





IRNSS

During this year, delivery of payloads for IRNSS constellation was a signifcant event. An era of new space application was initiated. IRNSS-1A payload was delivered from SAC on June 14, 2012. This was the first payload for which complete integrated payload level environmental tests were performed at SAC. Throghout the year spacecraft level test and integration activities have been performed.

Towards the end of the year on March 31, 2013, IRNSS-1B payload was also delivered to ISAC for further tests and integration. IRNSS -1 C is expected to be delivered in March 2014. T&E of HRF (S & L -band), output filter (L, S &C-band), S-Band Coupler and C-Band PSF completed. T&E (F.B.T) of L5/S band shared aperture Helix array antenna (QM) completed.

IRNSS receivers (payload test receiver, single/dual frequency SPS User Receiver, RS receiver, Hybrid Receivers) are being developed in SAC. Receiver Miniaturization through ASIC development is being planned. Shared Aperture Circular Array Antenna developed for the Navigation payload includes features like Co-centric Phase Center, Sequential rotation on group of elements, Low loss multi layer sq-coax. Feed NW, High Power Handling 150 W at L5-band, 250 Watts at S-band.

Navigation Signal Generation Unit

Rubidium- Clocks & Control Unit

Payload test Receiver

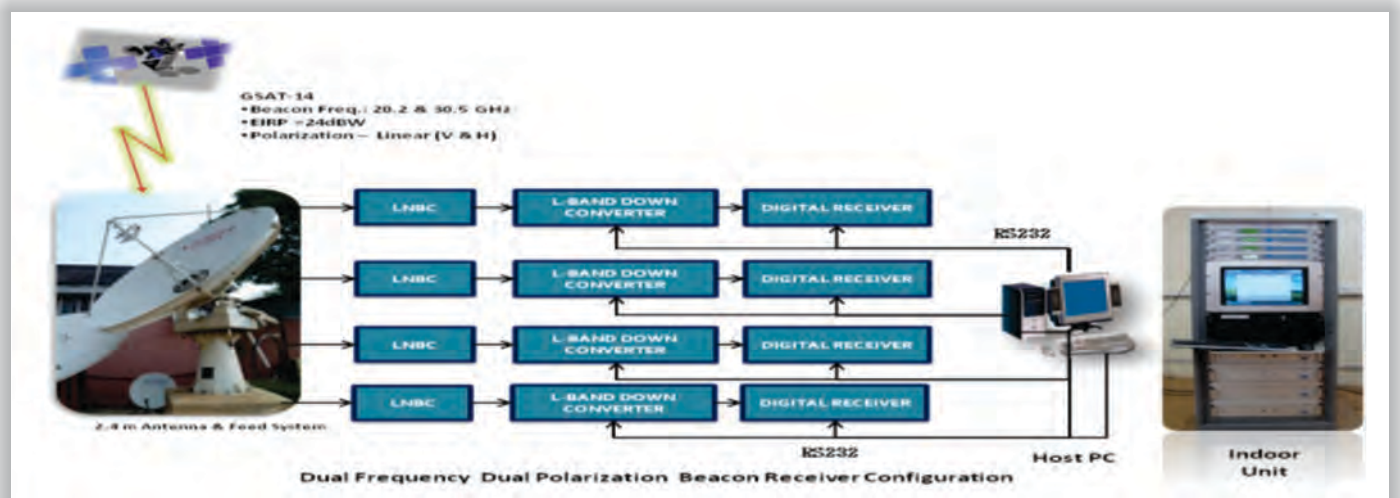
7 channel IRNSS Standard Positioning Services (SPS) URx was developed and tested with IRNSS simulator & Position accuracy of about 10 m is achieved. Further improvement is in progress. URx was also tested with simulator for IRNSS 7 satellite constellation (3 GEO, 4 GSO-without iono/tropo delay & satellite clock bias) the mean error of about 6 m is achieved. It is also tested with SBAS iono grid parameter correction and carrier phase based smoothing of code phase Pseudo Range (PR) and Standard deviation of position is improved up to 1.1 m.

Signal generator for 4 channel IRNSS signal simulator is being developed and feature enhancement is in progress. Newly incorporated features are Propagation delays for each simulated satellite signal, Effect of code and Carrier Doppler on signal for static user, Atmospheric impairments in generated signal due to Ionosphere and troposphere, Satellite Position Calculation module along with Range and Doppler values has been developed in PC, Generation of Navigation Messages for 7 satellites with real parameters along with display of navigation message fields.

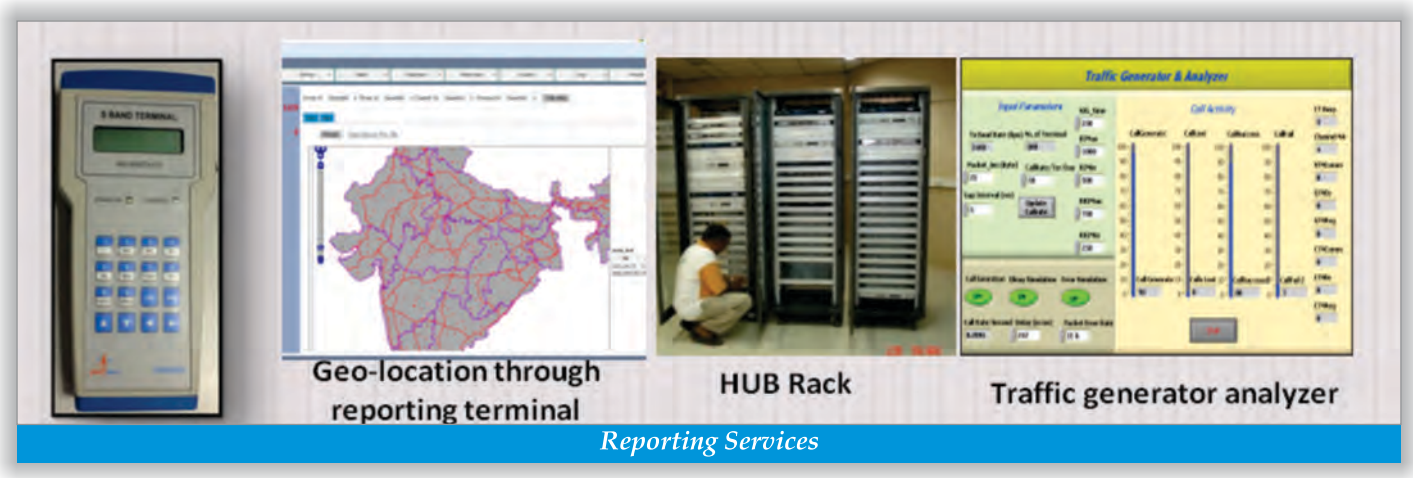
Two methods for generation of long codes for Restricted Services (IRNSS) have been designed. Provision for directly reaching particular code phase in the long code given particular time of day has been made. Segment wise correlation analysis of the long codes has been performed for different integration times (10 ms and 20 ms). Software implementation of the long codes has been completed.

Other SATCOM/SATNAV Projects/Applications

Detailed background document for Ka-band payload of I-6K, including major specifications of EIRP & G/T was generated. Three payload configuration options having different throughput have been worked out.



Ka-BAND receiver installed at DES for propagation experiment



Reporting Services

Under the Digital Tracking Receiver development, testing of POC model with single channel configuration tracking chain was carried out at NRSC, Hyderabad and two-configuration tracking chain at MCF, Hassan. Fixed point model of single channel digital tracking receiver (without AGC) developed. Simulation and hardware implementation is under progress.

GSAT-6: 8 Channel EPM card

Ka-Band Propagation Experiment (GSAT-14) has been planned with Indigenous Ka-band digital Beacon Receiver Installed at DES with dual Frequency, Dual Polarizations (20.2 GHz & 30.5 Ghz). Second receive station is under installation at SAC.

GSAT-6 applications have made considerable progress. Trial production of reporting terminal is carried out. Reporting service Integration & demonstration completed. Hub RF & baseband development of reporting service with Geo-location mapping feature is completed. Broadcast receiver breadboard is under testing. Integration & implementation of RS encoder, interleaver and rate ½ convolution encoder with BPSK modulator on FPGA completed at 51.2 Kbps data rate. Development of a generic modem ASIC with advanced features is undertaken keeping SCL foundry in view. This ASIC will feed into future SATCOM handheld terminals.

SAC has also extended the support during Uttarakhand Disaster management. A team of 14 members from SAC & DES was sent to affected areas. Five DMS communication nodes were deployed and Type-D terminals were extensively used.

Remote Sensing (Optics & Microwave) Payload Development Activities

The highlight of the achievements has been the launch & operationalisation of RISAT-1 satellite. RISAT-1 is an example of excellance & perseverance of the technical team at ISRO. In addition to this, during the year a completion of Pre launch T &E of INSAT- 3D payload and realisation of various critical payload subsystems of upcoming satellites were performed by centre. Payloads of Resourcesat-2A are expected to be delivered in 2013-14. Payload development of Carto-2C/2D, INSAT-3DR, Carto-3, GISAT and Oceansat-3 is under progress.

Resourcesat-2 Series

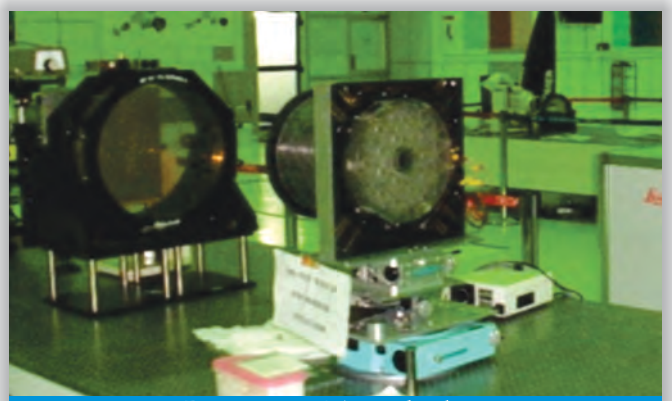
Resourcesat-2 Data product technique for Data Pulse Code Modulation (DPCM) artifact identification & correction has been developed, tested and operationalized.

Ressourcesat-2A; all payload sub-systems are available. Camera Electronics for LISS-3*, AWiFS-A (VNIR) & AWiFS-B(VNIR) has been realised. DHA (LISS-3 (SWIR)) is ready for integration. LISS-3 (VNIR) & LISS-4 are under T&E. New 6K detectors for AWiFS (SWIR) are being procured. Payload Integration of LISS-3* initiated and is expected to be delivered in December 2013. Development of AWiFS (SWIR) with new 6K detector is in progress.

Resourcesat-2A: payloads

INSAT-3DR and INSAT-3DS

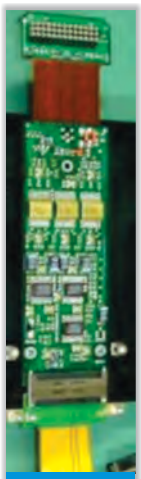
Package Design Review of DRT/SAR payload completed. All detectors, optics, Camera Electronics (CE) and mechanical items of both the payloads are available. Optical system assembled, tested & subjected to passive Thermo-Vac cycle and performance of imager optics evaluated post Thermo-Vac & found satisfactory. Payload optimization of Imager is in progress. Optimization of Sounder optical assembly with EOM structure and assembly bracket was completed. IBT, Thermo-Vac test and Spectral responsivity measurements on visible FM DHA of sounder completed. Validation of Spacecraft Interface System unit with integrated hardware and software of sounder is under progress.



Resourcesat-2A: payloads

INSAT-3DS, the ground spare is also under development with the detector head assemblies nearing completion.

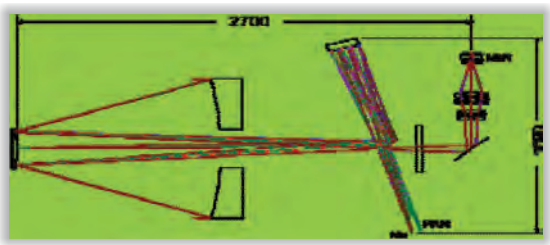
Cartosat-2 Series


BCD CARD

Cartosat-2C, the next payload in the Cartosat 2 series, will feature a four band multispectral camera as well as two Event Monitoring Cameras in addition to the Panchromatic camera. Significant work has been carried in the past year in the development of detector test benches for MX and PAN, with available PAN detectors (EM) up screening in progress.

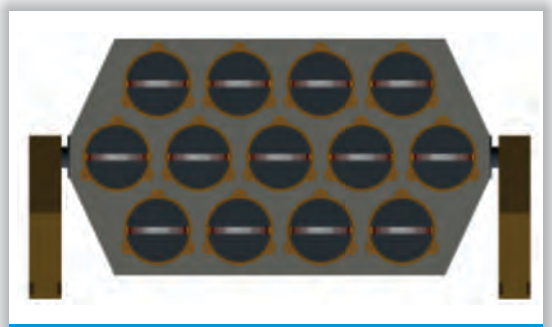
Payload PDR completed during June 27-28, 2012. Verification model detector head assembly development is in progress and four band TDI detectors have been received. MX Designs (CE) of 1.57m Multi-spectral band (4 bands, VNIR) completed. PCI based DAQ and PDR of structure (CMSE) of Event monitoring Camera developed. Event Monitor -1 (VM) fabrication is in progress. 8K TDI detector test-setup is developed and delivered. Overall, the project is on track with payload delivery expected to be in the first half of 2014.

Cartosat-3 Series



Cartosat-3 has ~0.25m panchromatic band, 1m Multi-spectral band (4 bands, VNIR), 5m MIR band or 12m HYSI-VNIR & HYSI-SWIR (alternate flights). Onboard radiometric, correction - Real time 40 Gbps data acquisition, compression, onboard 1.6 TB data storage & transmission features will be incorporated. Configuration studies and options were worked out. FM detector

OCEANSAT-3 Series

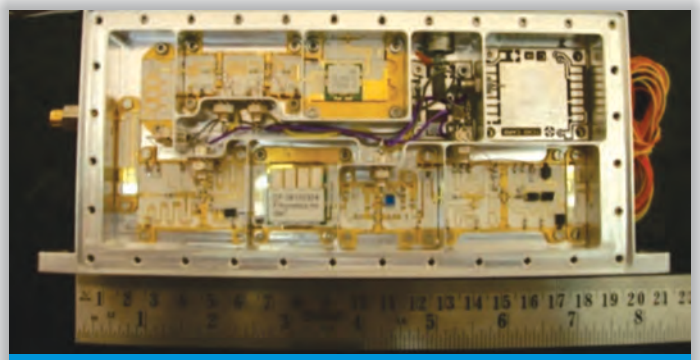

OCM

Oceansat-3 has Two Electro-Optical Payloads -Ocean Colour Monitor (OCM) – 3 and Sea Surface Temperature Monitor (SSTM) – 1. Ocean Colour Monitor – 3 features 13 spectral channels for ocean colour science and atmospheric corrections, better radiometric performance, and targeted SNR greater than 10. Optical design completed and a prototype lens assembly is to be fabricated by LEOS in one year.Payload configuration studies and Optical design of Sea Surface Temperature Monitor – 1 are in progress. In addition, Microwave sensors are also planned namely Ku-band Scatterometer (Repeat) and mm-wave Temperature Sounding Unit (TSU).

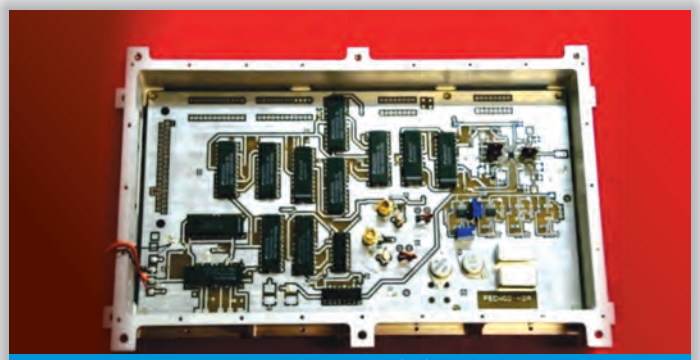
GISAT Series

GISAT-1 PDR was completed in August, 2012. Specifications of the Imaging payload are finalized and several improvements made. CE-Modulator integrated test successfully completed. DVM VHDL design of MIL-STD-1553 based Payload Controller and cooler drive electronic has been completed. A High Bit Rate Data Transmitter is being developed to Transmit Metrological and Remote Sensing Data from Camera Electronics to downlink in Ku-band. Integrated testing of DVM of "200 MBPS QPSK Modulator with 7/8 FEC ", U/C, LO and BPF of Data Transmitter completed.

Results verified using "Cortex Demodulator". Temperature cycling of combined DVM package ("200 MBPS QPSK Modulator with 7/8 FEC " & Camera Electronics) is completed. Sub-Harmonic Mixer in IF-to-Ku band



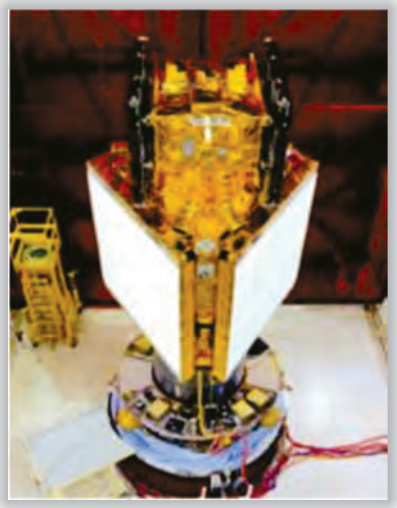
LO Trays



200 Mbps Modulator

Up- converter developed. 64 nos. of SSPAs with 0.63 W output power each are under development. Fabrication of 24x24 waveguide fed EM coupled stacked microstrip patch array antenna (12.35 GHz ± 100 MHz) completed.

RISAT-1



RISAT-1 launch and Operationalisation is the signifcant event of the year 2012-13. It has added bright feather in the SAC's cap.

C Band- SAR of RISAT-1 is successfully operating since launch on 26th April, 2012. All planned modes are successfully execrcised viz.Stripmap (3m res.), ScanSAR (115km, 220km swath) and Spotlight (1m resolution). Circular polarimetry with all the above modes done and accordingly Antenna patterns were characterized.

During the year a varous activities were also performed at Data Product areas. RISAT data products were released at NRSC by Chairman ISRO on October 19, 2012.

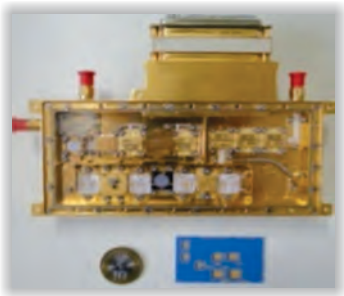
FRS-1 Delhi Region

Two QLP/NRTP systems along with data recording system installed at IMGEOS and two QLP/NRTP systems along with data recording system installed at IMGEOS and the pre & post launch activities for QLP/NRTP systems were completed.

ScanSAR (MRS CRS) images for various imaging sessions using end to end NRTP system were generated. Installation of the automated QLP systems & Payload Performance Evaluation (PPE) mode in IMGEOS

environment, Hyderabad was completed. Processing of Amazon data using new synthesized elevation antenna patterns to analyze the antenna pointing accuracy was also completed. QLP software development for MRS/CRS mode was completed. Calibration exercise was carried out on December 14, 2012 at SAC SRC ground for orbit 3508 by deploying. Development of software for reading and displaying QLP generated process data at ISTRAC completed. Installation of Quick Look Processor for MRS/CRS mode at NRSC, Shadnagar was also completed. Installation and testing of software for displaying QLP generated processed data at ISTRAC and its associated software module at NRSC was completed. Data Quality Evaluation (DQE) System is in operations at NRSC Balanagar. SAR Calibration using corner reflector based point target data, onboard calibration data, Amazon rainforest data is being done. Geometric parameters in terms of location error are evaluated using qualified references.

RISAT-1A



RISAT-1A a follow on of RISAT-1 has improvement in TRM Noise-figure, and thereby system SNR and Deck systems miniaturization compared to its predecessor.
Significants efoorts towards design and development of LTCC based compact TR module with 250 mW transmit power and 3 dB noise figureare being made.

RISAT-3

RISAT-3 (L-band SAR) has circular and full-polarimetric modes, Along-track interferometry mode, Azimuth and Elevation beam steering capability and Onboard SAR processing. TR-Modules with True-time delay phase-shifters were developed for 18% bandwidth. Characterization of baseband-systems and TRMs is in progress. PLC package is ready for integrated testing. Total 17 Units of TRiM were received from Astra Microwave, Hyderabad and another 8 units are under final stages of testing. Development and Testing of Microcontroller Software for TCU application completed. Evaluation of 12-bit ADC 12D1X00 from National Semiconductor on evaluation kit (ADC 12 D1X00-RB) using sine and chirp signals completed. Development of L band DVM antenna completed.

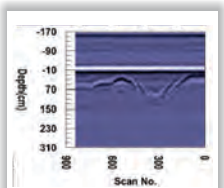
NI-SAR (L&S-band)

It is a Joint ISRO-JPL/NASA Mission. Technical Assistance Agreement (TAA) has been signed between NASA & ISRO where in S-band SAR will be developed by SAC and L-band SAR & Feed-Structure will be developed by JPL. 24 TR-module configurations are based on Sweep SAR concept. System Studies was carried out. Hardware development initiated. Airborne demonstrator with simultaneous L & S-band operation planned and development is in progress.

Ground Penetration Radar (GPR)

GPR: Integrated system

At Snow Park



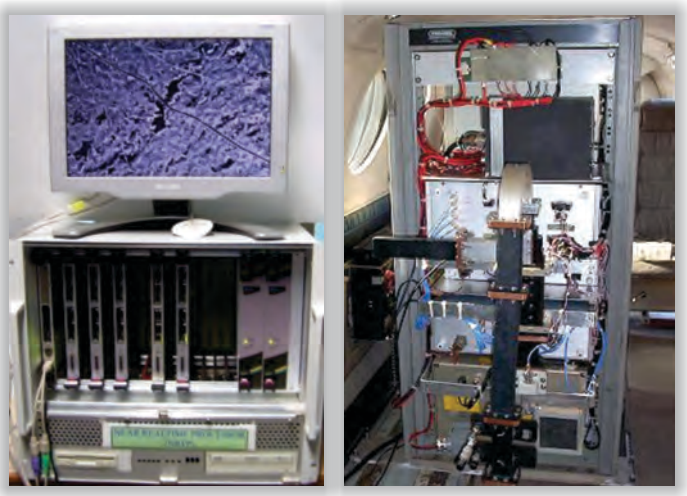
Results at Snow Park

GPR was developed for snow accumulation studies at Antarctica. Testing of RPC with Antenna completed and performance was optimised. Detailed characterization of integrated Rx & frequency-generator subsystem completed. DPU ver-1.0 testing completed and delivered to Science team. Characterization was done at a Snow Park and Manali glaciers.

DMSAR

C- Band FM DMSAR flagged off for integration with aircraft at NRSC on December 24, 2012. Flight planning software (Version 1.1) was realised.

Rack integration and second DVM PLC package fabrication & testing of X-band DMSAR was completed. Design, development and testing of DVM EPC for TR Protection Switch were completed. T&E of C&X dual band FG was completed. X-band DMSAR (Airborne) DVM was realised in January 2013.



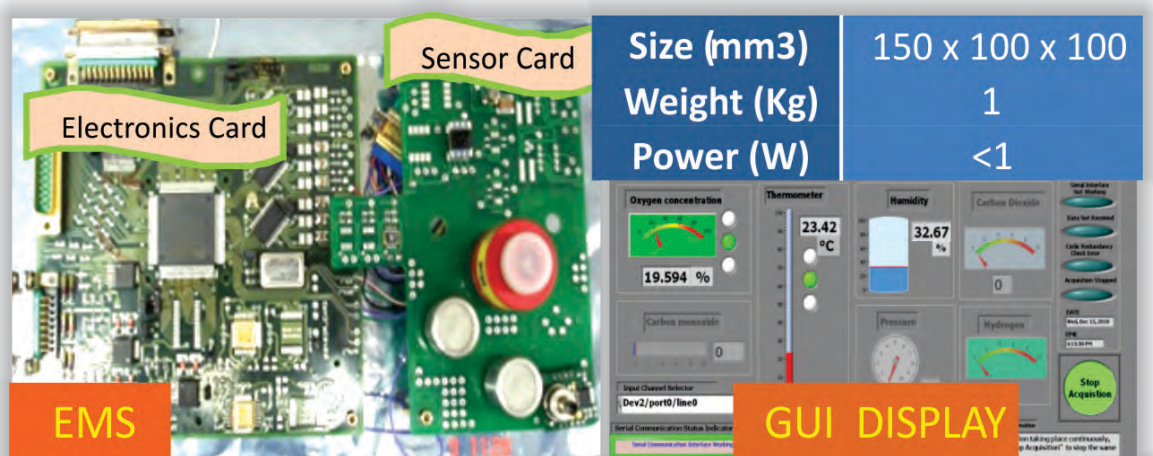
Temperature Sounding Unit (TSU)

TSU DVM with 15 channels in 50-60 GHz alongwith 23.8, 31.5GHz was realised in December 2012.Onboard BBTs for Hot-load Cal is being developed.Integration and checkout is in progress.

TSU DVM Systems

Human Space Programme (HSP)

Two Bread Board Model (BBM) Payloads (BBM Cabin Lighting & Control System) were delivered to VSSC for further integration and testing with sub-systems. Gas Monitoring System for ECLSS is for Monitoring of Oxygen, Carbon dioxide, Temperature, Relative Humidity. Cabin lighting system is solid state and will be used for illuminating the crew cabin.



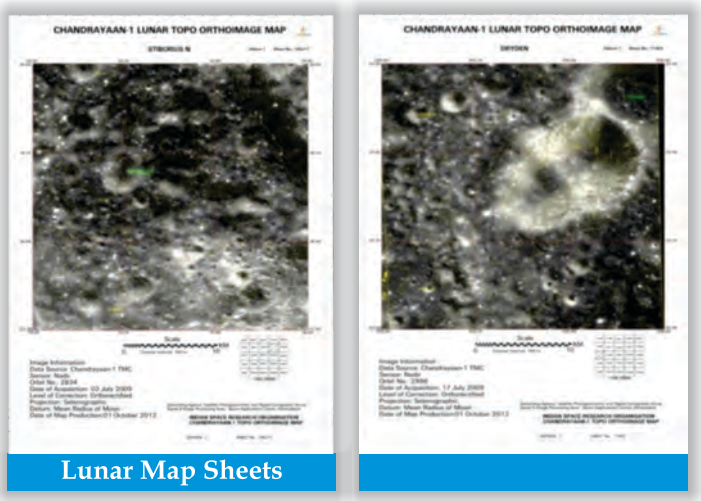
Gas Monitoring System for ECLSS

South
West
North

Planetary & Astronomical Missions

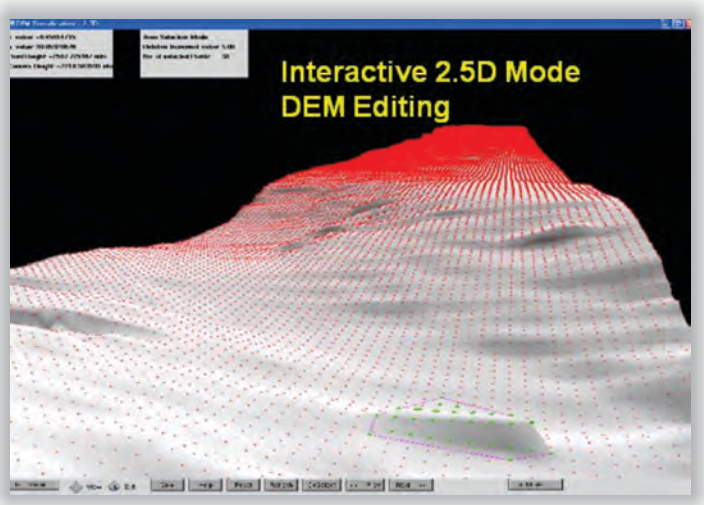
Chandrayaan-1

Chandrayan-1 long term archive (LTA), digital elevation model (DEM) & samples of lunar map-sheets were released on 19th April 2013 through http://www.issdc.gov.in/CHBrowse website. Lunar Control Points (LCP) creation using Chandrayaan-1 (Ch-1) Terrain Mapping Camera (TMC) triplet images using GEMS indigenous software was accomplished. LCPs generated for 516 TMC orbits. Lunar Magmatic water has been discovered using Chandryaan-1 data. Chandrayan-1: Lunar Science Atlas released containing the scientific highlights of the Chandryaan-1 mission.



Lunar Map Sheets

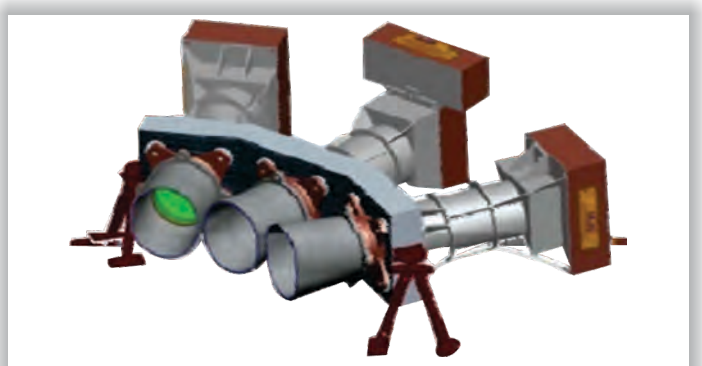
25 metre Grid Interval DEM Generation completed and disseminated to users through ISSDC. Interactive DEM (10 meter) editing software in 2.5D mode for correcting artifacts in the terrain heights was developed. 10 Meter Grid Interval DEM Generation is in progress. Generated 10000 map sheets for TMC-1 Atlas generation.



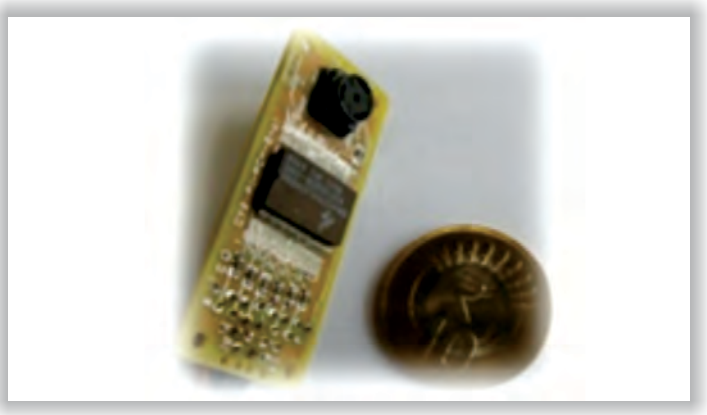
LCP creation using CH-1 TMC triplet images using GEMS indigenous s/w was accomplished. LCPs were generated for 516 TMC orbits. In total 17152 LCPs records were also populated in LCP Database. Generated LCPs has used LDEM, Orthoimage, Evaluation of Lunar images and is useful for future Moon missions.

Chandrayaan-2

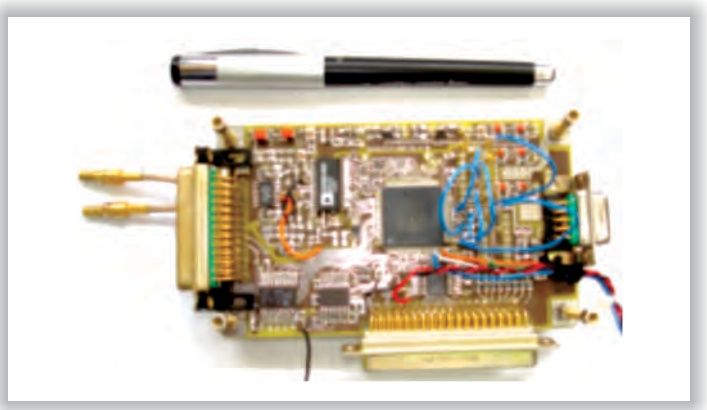
Singificant progess has been achieved on various payloads of the Chandrayaan-2 (Ch-2). One of the payloads, TMC-2, was further miniaturized with respect to TMC-1 (Chandrayaan-1) & weight was reduced by 1/3rd. PDR of Optics fabrication at LEOS completed and the lens assemblies being fabricated. Miniaturized camera electronics (VM) was qualified.


Chandrayaan-2: TMC

VM of Rover camera was developed and qualified; FM PCBs are ready. The optical design of Imaging Infrared Spectrometer (IIRS) was completed & documentation prepared. Disassembly of IR fore & focus optics lens assembly of TIS carried out and mechanical measurements of barrel, mounts completed. Thermo-vacuum of reflection grating and two lens elements of disassembled lens assembly completed. Optics & detector of IIRS are finalized and in ordering stage.

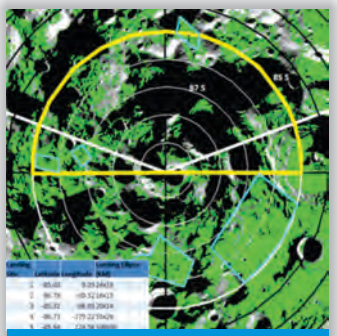


DVM checkout of Dual Frequency SAR was completed. Testing & characterization of DVM package of S-band integrated FG & Dual Pol (V&H) Receiver along with temperature operational testing with EPC was completed and delivered for further integration. 1/4th Antenna for Dual Frequency SAR was also developed using light weight material. Developmental model of L/S band 1/3rd Array dual band polarized antenna characterised in anechoic chamber. Ka-band Altimeter for Chandrayaan-2 Lander is being developed.

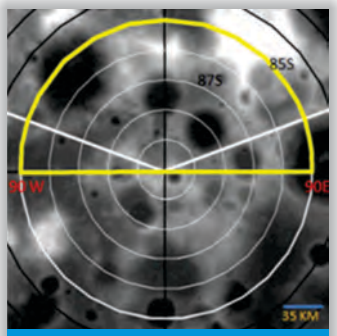


Lander, Rover Data Processing

To perform soft landing on lunar surface, deploy the Rover and demonstrate its mobility, a considerable work has been carried out. Landing sites selection and characterization for 70-90 deg latitude regions in South and North poles is progressing well. Study and simulation exercises have been taken up for Hazard Detection and Avoidance (HDA) for Lander safe landing. Extended Qualification of Rover Imager is under progress.



Probable Landing Sites - South Pole



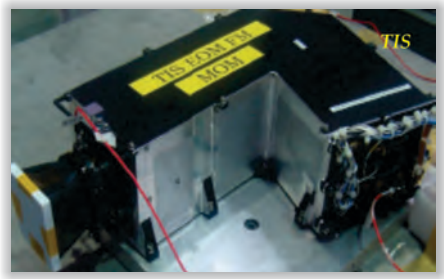
LOLA DEM (20 m Grid)

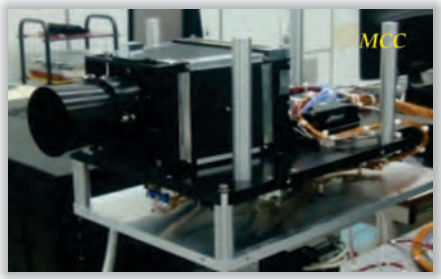
DP software requirement has been identified for Ch-2 in addition to existing Ch-1 DP S/W. Simulations and Software Development for Ch-2 DP for TMC-2 & IIRS is under progress. Characterization of landing site using LROC-NAC (50cm) is in progress. Simulations on landing sites Identified for Diff. earth and Sun illuminations. Adhoc Rover Test facility has been established at Bopal Campus.

Mars Orbiter Mission (MOM)

Three Electro-optical Payloads (Methane Sensor for Mars (MSM), Thermal Infrared Imaging Spectrometer (TIS), and Mars Colour Camera (MCC)) were developed and delivered for spacecraft integration in June 2013. Three models (Flight Model (FM)-like; Flight Model (FM); FM Spare - (Ready for T&E)) developed for each of the three payloads. Earlier, Payload PDR was completed on August 22-23, 2012.
Software for Level-0, QLD client developed. Calibration exercises for MSM, TIS and MCC performed. Highly

automated Scheduler for data products generation and Browse software completed. STK simulation and generation of simulated products completed. PDS archive specification and implementation completed. PDR, DDR and Internal T&E completed. Software is ready for porting to ISSDC for final T&E. S-band antenna has been characterized at CATF, SAC with ISAC feed. RF results meet the specifications



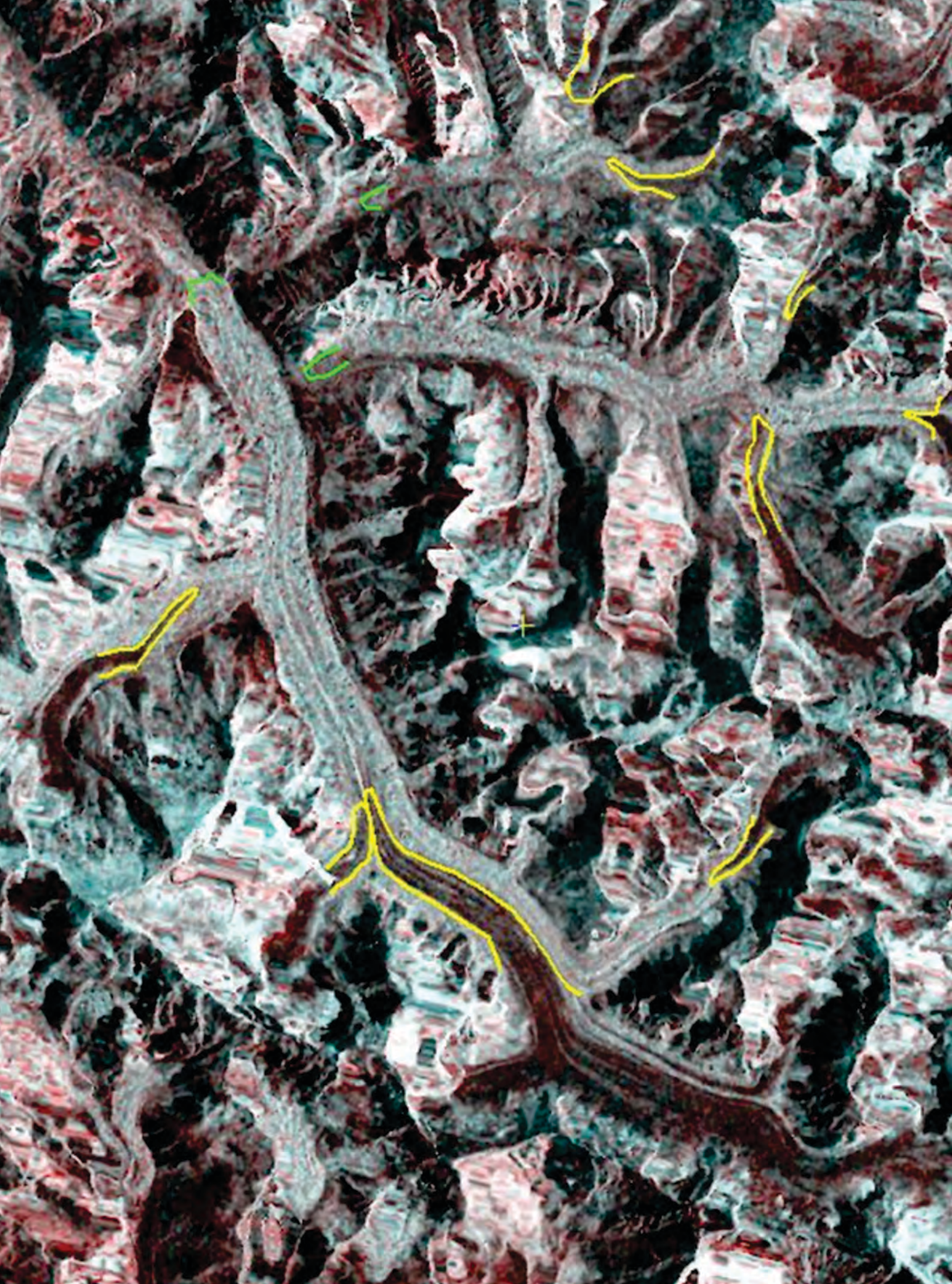


Astrosat

Prelaunch T&E of Software Development for Data products of ASTROSAT Payloads was completed in November 2012. CDR for Data Product software was completed. Detailed design document for SXT, CZTI, LAXPC and UVIT has been generated. Development of software for Level-2 pipeline & QLD for four instruments were completed. Internal T&E was completed for QLD and Level-2 software. Development of CZTI Real-time Server and Client was also completed. QLD Interface testing at ISSDC/BL4 was completed. S/W is ready for porting at ISSDC & POC and final T&E. CDR document related to Level2, QLD and Archive Browse and dissemination has been finalized.

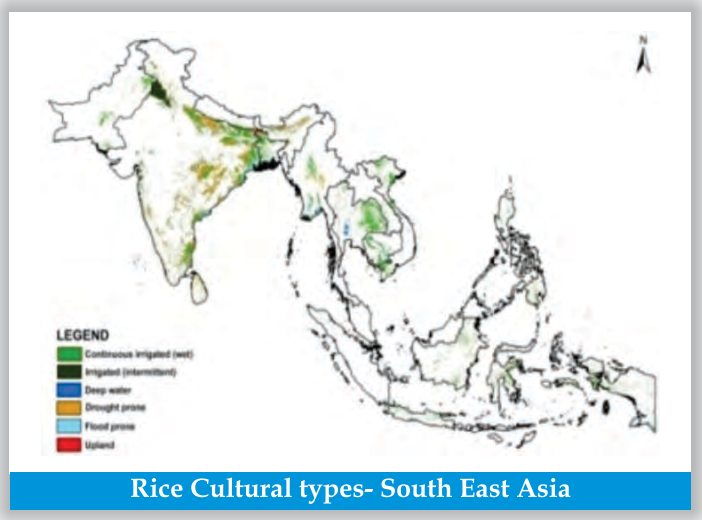
Aditya

Development of Detector Test Setup involving Data Acquisition hardware, Clock Generation subsystem, Raw Data Processing and Applications software was completed and delivered to project. Development and testing of Data Simulator card has been completed.



Earth Observation Applications

Agriculture & Agro ecosystem Studies:



Rice Cultural types- South East Asia

Integrating of RISAT-1 data in FASALSoft software & the Automated/Integrated software support to M-NCFC was completed. The NSF-module was designed & developed alongwith the latest Jute 2012 Data (Microwave/radarSat) for the FASALSoft Web GIS module. Twelve states were configured for Kharif Rice Forecast at M-NCFC, New Delhi. Support was provided for Rabi crop forecast. RISAT-1 MRS data workflow was integrated and tested with Rabi rice season data at MNCFC. Multi Date RISAT-1 MRS Chain was operational since March-2013. The multi-date SAR data was used for cotton crop discrimination in Punjab, Haryana and parts of Andhra Pradesh. Multi Date RADARSAT ScanSAR/widebeam-2 Chain was operational since June-2012. It was also used for the crops Jute and Kharif Rice. FASAL Forecast has been achieved for wheat-mustard-potato 2012-13, RabiRice-2013, Jute-2013, and Kharif Rice – 2013. During the year for 8 crops 12 advance estimates were carried out.

Early area estimation of Sugarcane using multi-date AWiFS data for year 2012-13, 2013-14 for UP, Maharashtra & Gujarat was carried out.

Spatial crop yield modelling based on SAR backscatter and rice biomass was evaluated for 13 states for the year 2012-13. Onion crop area estimation with NHRDF, Nasik is continuing. The deficit production was estimated and forecasted during the year 2012-13.

National Food Security Mission: Pulse Intensification Programme in UP and MP has been initiated. Last year two estimates were given. This will continue with addition of new states. Wheat Rust Disease prediction based on met data for the year 2012-13 is planned in the current year.

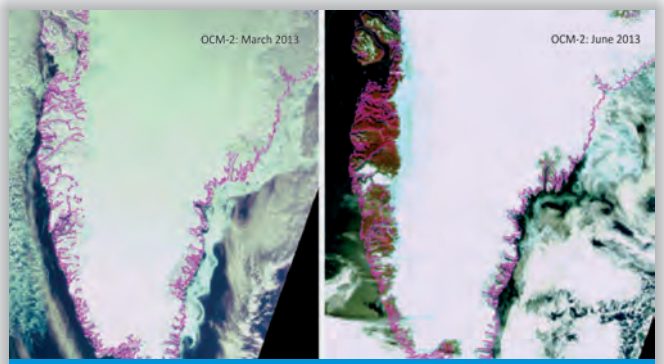
Energy and Mass Exchange in Vegetative Systems: Techniques were developed for ET modelling within energy balance framework using optical-thermal data & for regional gross primary productivity (GPP) using light use efficiency (LUE) model and vegetation fraction from Geo satellites. Validation is planned using aggregation and disaggregation models. Rice cultural types and spatial crop calendar was also derived for South and Southeast Asia.

Bringing Green Revolution to Eastern India (BGREI): Document on BGREI was submitted to the Secretary and Joint Secretary, Agriculture, DAC and Director, Agriculture, Govt. Odisha. A presentation has been made to the review committee on the findings/evaluation of SAR data to assess the potential of the program in all districts of Odisha. Scene-wise analysis to compute Odisha state level yield figure showed an improvement of 15% in 2012-13 as compared to 2011-12.

Polar Science Studies

Sea Ice Applications: Sea ice cover mapping techniques were developed from the SARAL-AltiKa waveform peak and Sigma-0 waveform parameters. Sea ice flagging software and climatology have been modified for the 25 km and 12.5 km product generation.

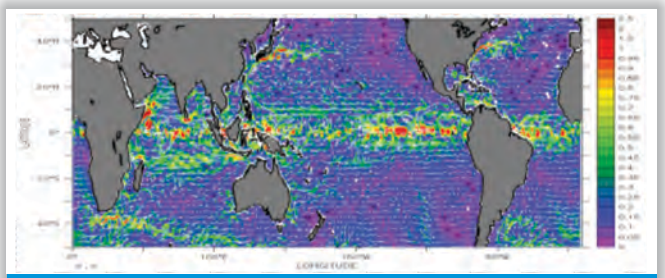
Ice Sheet/Ice shelf studies: Confirmation of thinning and advancing of Amery ice shelf using OSCAT, RA2 altimeter and RADARSAT data was achieved. Greenland Surface melting and change detection for the year 2012 *vs*. 2013 has been done using 12.5km daily 10-day running average OSCAT Sigma-0 data. OCEANSAT-1 OCM data was also used for Greenland Ice melt detection.



Rice Cultural types- South East Asia

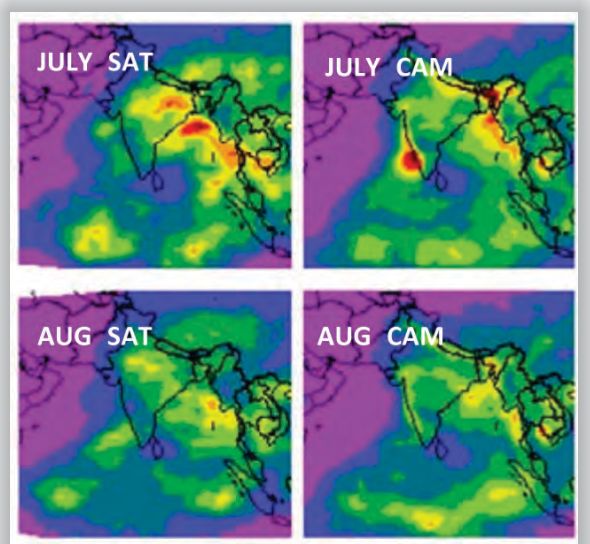
SARAL-ALTIKA – OCEAN, COASTAL and INLAND WATER APPLICATIONS

In-house algorithm has been developed to retrieve Sea surface Height and Significant wave height information using SARAL/Altika IGDR data. Retrieval of water level fluctuations over the major water bodies of India has also been demonstrated using SARAL waveform retracing algorithms. Coastal ocean retracker for 40-Hz AltiKa data and Inland water retracker were developed & tested over Ukai Reservoir. Ocean current generation using combined data from AltiKa & OSCAT winds has been demonstrated.


Ocean surface current from Altika and OSCAT

Weather Monitoring and Prediction

Pre-launch T&E of Software for Data products of INSAT-3D Payloads was completed in December 2012. Monthly-to-Seasonal prediction of monsoon rainfall using Community Atmosphere Model has been completed. Assimilation of SAPHIR radiances & AMV winds in NWP models was also completed. Studies using Now-casting of heavy rainfall events over Uttarakhand has been successfully demonstrated. A technique has been developed for 10-day advance prediction of cyclogenesis and tracks with Multi-model approach. GIS based cyclone analysis system was developed.



CAM Model forecast of Monsoon rainfall (right panels) for 2012 and their comparison with satellite Observed rainfall (left panels)

Ocean & Coastal Applications

Data-assimilative model has been implemented at Indian Navy for real-time analysis and prediction of ocean state. Near Real Time Storm surge prediction for Mahasen cyclone was also demonstrated. Assimilation of SARAL/Altika wave and Sea level anomaly & SMOS/Aquaris salinity in ocean models were done.

Projects related to Ocean colour, retrieval of geophysical parameters, biological oceanography, coastal and geological oceanography and Calibration and Validation under Oceansat-II UP and MOP-II have been completed. Closure reports have been prepared. Results were presented during project closure meets organized at SAC on March 07-08, 2013 (Oceansat-2) and March 20-21, 2013 (MOP-II). New MOP-III umbrella program has been initiated. Comprehensive proposals on Coastal Geology and Marine Biology as part of MOP-III Programme and Planetary Sciences including Mars Science Plans were prepared, documented and reviewed.

Sea Surface Height (SSH) from SARAL/Altika along with SST & Chlorophyll was included as additional parameter for Fisheries Habitat Suitability. Primary Production for euphoyic zone has been made an operational product. A Chlorophyll Atlas for Indian Ocean was completed and released. Coastal Bathymetry was generated using RISAT-1 data off the coast of Mumbai and Shoreline change atlas of India has been prepared on 1:25,000 scale. A book on Coastal Zones of India was also released.

Environment & Climate Change Studies

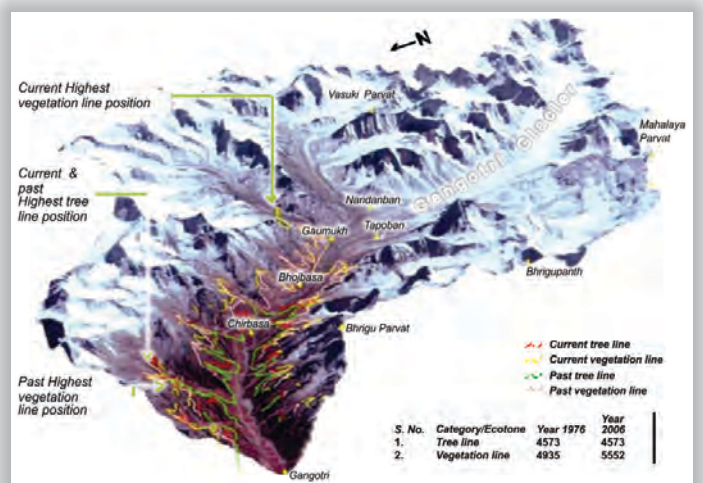
Himalayan Glacier studies: Himalayan Snow cover Monitoring for their Retreat/ Advance status has been generated and it is found that 87 % glaciers are stable, 12 % are retreating and 1% glaciers are advancing, Glacier mass balance using AAR approach has also been carried out. During the year, 10 daily snow cover maps were prepared for 30 basins of the Himalaya. In addition to this Glacier mass balance estimation for 2011 was done for 10 basins.

Alpine Ecosystem studies: Average shift of alpine tree-line shows that the fundamental niches of Betula Utilis tree have moved upward by 184 m in 7 decades. The future niche modelling based rate of change has been estimated to be 3 meter/yr.

Green House Gas Monitoring: Analysis of the atmospheric CO_2 and CH_4 variability over India using GOSAT has been done. Found inter annual increasing trend in CO_2. Satellite based CO_2 and NDVI measurements were found to have inverse relationship at Kanha and Ranthambhore sites.

Coral reef ecosystem studies: Reef Habitat Maps generated covering Red Sea & Gulf of Aden, Western Indian Ocean. In situ Reflectance Spectra of Reef Substrates & Dominant Coral Genera for Andaman region has been done.

Desertification Status Mapping: 2nd Cycle of Mapping of Desertification Status using 2012-13 IRS data is in progress by involving 21 Collaborative Agencies.



Gangotri Catchment's perspective view

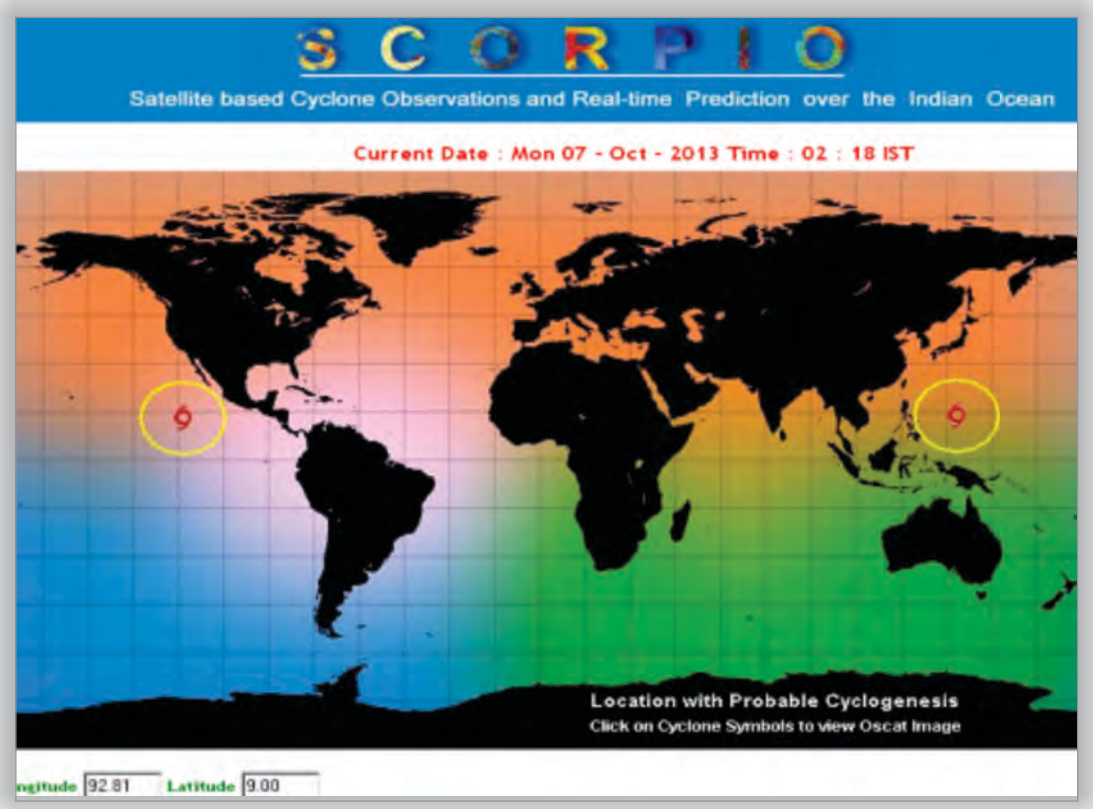
Megha-tropiques DP Activities

During the year MT L1A & L1A2 of SCARAB & SAPHIR products was released to science community jointly by CNES & ISRO. Data Products are operationalised at ISSDC & BOPAL. Modification on ISRO-CNES agreed algorithm for geo-location & radiometric correction for MADRAS, SAPHIR & SCARAB data was implemented. Global bias of bending angle products is within 2-3% of error against ECMWF 5-20 km of the atmosphere. Updated DP Software for O2 & MT ROSA was installed at NRSC-S & ISSDC.

MOSDAC & NRDB Activities

New version of MOSDAC website has been released. MEGHA TROPIQUES & SARAL data products are available in MOSDAC. Cyclogenesis, Track forecast with Intensity was released in Satellite Based Cyclone Observation and Real-Time Prediction over Indian Ocean (SCORPIO) Portal. Web application for generating SEA STATE ATLAS was released. CALVAL Web site providing ground measured data for MEGHATROPIQUES & SARAL released. Validated Products released are OSCAT VALUE ADDED PRODUCTS, WRF FORECAST (5X5 km grid) and KALPANA Winds & Hydro Estimator Rain.

Total Number of Layers (NRDB contains systematic archive of all thematic layers generated under various ISRO-DOS projects which includes NRIS, Wasteland, NRC, Wetland, Desertification, National GIS, etc.) in NRDB is 1353 and New layers added are 128 (WETLAND-India 2008-16, NRC project layers for year 2008 state level-29, WETLAND state wise 2008-83).


SCORPIO
Satellite based Cyclone Observations and Real-time Prediction over the Indian Ocean
Current Date : Mon 07 - Oct - 2013 Time : 02 : 18 IST
9
9
Location with Probable Cyclogenesis
Click on Cyclone Symbols to view Oscat Image
ngitude 92.81 Latitude 9.00

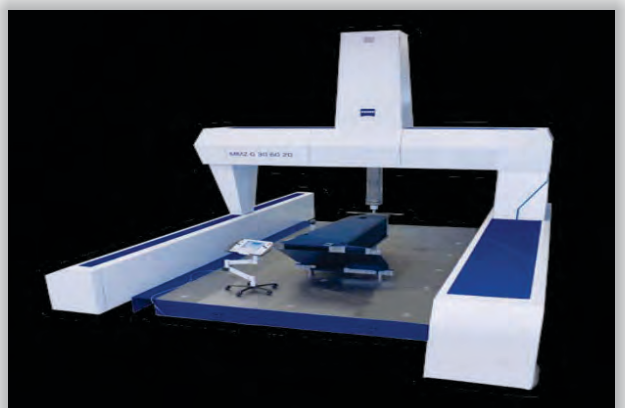
Facilities & Processes

During the year a large number of facilities have been augmented to cater to the future demands of the payload developments in the Centre. Some of the major facility augmentation is mentioned below;

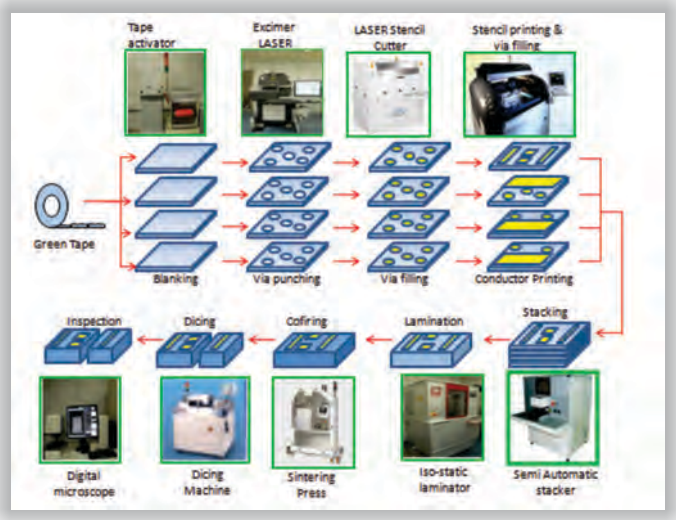
- Pin less registration system for multi layer PCB.
- 3D CT X-ray Inspection system with 4 µm resolution for wired PCB assemblies using Area Array Devices (BGA, CCGA, QFN)
- Automatic Optical Inspection system with 45 µm CD and panel size of 0.75mx1m for in-process inspection and repair of PCB
- EB Lithography tool with 100nm capability
- 3m Thermovac system with New Thermal system, super insulated LN2/GN2 lines, New Instrumentation and Control system & Data acquisition system.
- Co-ordinate Measuring Machine (3D CMM) with Range of X – 3000 mm, Y – 2000 mm, Z – 2000mm and Probing Accuracy 2.5 Micron.
- Upgradation of CATF for mm-Wave testing
- Facility Augmentation and Upgradation for Calibration & Validation of satellite sensors
- A major beginning this year was initiation of establishment of LTCC Facility for miniaturisation of packaging for Microwave, mm Wave and Cooled EO detectors being established. 8 out of 9 equipments needed for LTCC process installed. Supports Conductor line spacing and via of 100 µm. Process optimisation & Sample availability is expected by December 2013.

Pinless registration system

3D X-ray

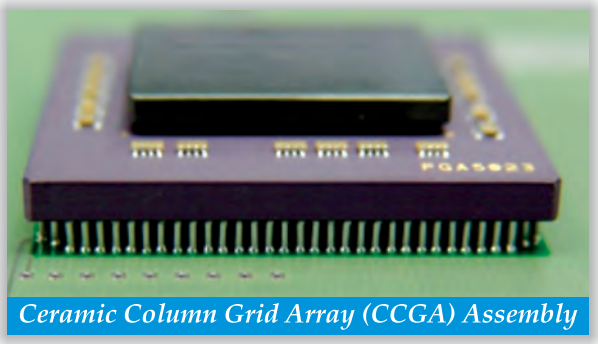

3D CMM

EB Lithography system with 100nm capability

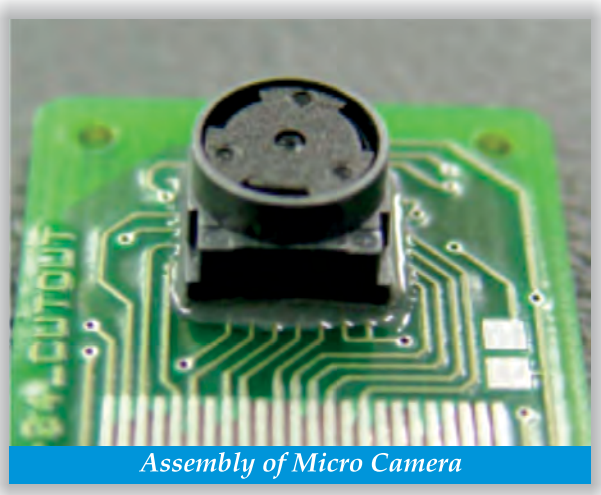


In addition to this, 12 (1 at Vendor facility) new processes were qualified.

- Hermetic sealing of microwave packages using LASER welding, with micro-D connectors and feed-throughs
- MIC assembly on Silver CP
- Reflow Soldering of Ceramic Column Grid Array (CCGA) with Hot Gas
- Assembly of Micro Camera , used in Chandrayaan-II
- Assembly & Soldering of Quad Flat Pack No Lead (QFN) devices
- Dicing of 10 mil thick alumina substrate for high aspect ratio MIC
- VOQ for 0.8mm & 1.6mm Double Sided Boards
- VOQ for NPTH gold plated RT duroid RT-5880
- Gold and Silver Plating on CE-7
- Black Thermal Coating on Kepton Tape
- Gold plating on Copper-Molybdenum
- M/S Hi-Q Electronics qualified for bare PCB upto 10 layers.



Ceramic Column Grid Array (CCGA) Assembly



Assembly of Micro Camera

Reliability & Quality Assurance

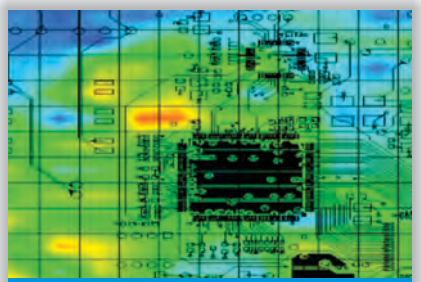
Reliability & QA activities are weaved in all core activities of SAC. During the year, towards Reliability & Quality Assurance various initiatives have been taken. Set-ups for simultaneous testing of multiple sub-systems in automated mode have led to increased throughput and Repeatability. Test libraries and Design Pattern for automating the execution of tests on Micro controller Simulator was developed. Automatic functional verification of FPGA Designs using advanced techniques was developed.

"Heritage Hardware Reuse Assessment Plan" and "Hardware Design FMECA Methodologies" document was generated. Generation of "compendium of construction details: Passive parts" was completed and circulated to Centres of ISRO. Communication Payload AIT integration process document was also prepared.

"Traceability System for Mechanical Parts in Space Payloads" was developed and implemented. Detailed guideline for AIT activities for Communication Payloads is being generated.

EMI Scanning system for PCBs was operationalised for troubleshooting. SAC has provided significant inputs by participations in DSRQ meeting for revision of workmanship standards.

Traceability for Mechanical Parts & Subsystems



Automated EMI Scanning system for PCBs

Integrated Emission & Susceptibility Test System

GROVE
TOUCAN

Research & Development and Indigenisation

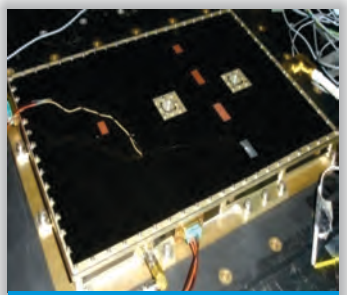
During this year SAC has initiated Research & Development and indigenisation of several critical technologies to be used as a part of ongoing and future satellite payloads.

Technology Development Program (TDP)

Currently, 191 Technology development activities (34 new, 97 on-going, 60 completed) are going on in the centre. Some of the major TDPs are mentioned below;

- W & V Band Amplifier
- Optical Tx & Rx Module (675 Mbps)
- Atomic Clock development
- Secure Satcom Systems
- Message Courier Hosted Payload (MCHP)
- L-Band 150 Watt GaN SSPA
- Transparent Processor
- Signalling Demodulator
- Traffic Generator and Analyser
- Ka & Ku-band Miniaturized LNA & Converters
- Ku & Ka-band Antenna Tracking systems
- Ku & S-band Multiport Amplifiers
- Ka-band filters/multiplexers
- Digital Beamforming Network
- High-Power Ka-band OMT
- L-band TR Module
- LTCC Based Miniaturised TRM
- High Gain MCM
- 540 W EPC
- Integrated Digital System
- 9 bit Time Delay Phase Shifter with 6000ps delay
- Ultra wideband, ultra-low noise 50-60GHz LNA
- Ultra wideband sub-harmonic 50-60GHz mixer
- Ultra-low noise 35.75GHz LNA
- Combined FG+dual Rx
- 210 W CW SSPA with >45% efficiency
- RF packaging of LEOS-MEMS switch
- On-chip spiral inductors
- Ultra wideband VCO
- Integrated EEPROM Based Controller
- NRTP system
- Active Radar Calibrator (ARC)
- X-band Ferrite Switch
- Point-of-Load Converter (POL)
- Four Channel Rotary Joint for quad beam dual frequency scatter meter
- Waveguide Slotted Array Antenna for SAR
- Electromagnetic Band gap Antenna for Large Scanning Phased Array Applications
- Ultra wide Band Antenna for Ground Penetrating Radar

3-StageV-band Amplifier



210 W CW SSPA with >45% efficiency

Proto model of POL Size: 50x45x20 mm^3 (~2.8 inch)

Indigenisation

During the year Qualification was completed for the following Indigenised Components & Processes:

Components

- Oven Control Crystal Oscillator (OCXO)
- Cable Ties

Processes

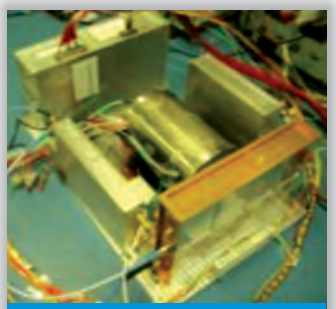
- Gold Plating on Aluminium, Invar and Kovar.
- Electro less Nickel plating on Invar Specimens

Qualifications activities are in Progress for

- Crystal Filter
- Flat Pack Resistor Network
- SFT Header
- Capacitor Feed Through Filter
- Black thermal paint and epoxy like EC-2216

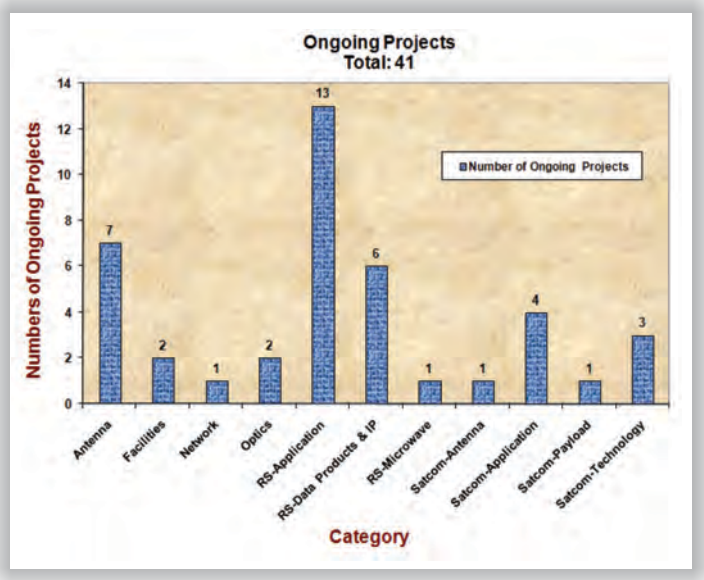
OCXO

Crystal Filter



During the year, a significant work has been carried out for the development of Indigenised Atomic Clock for the Navigation payloads. A Working model is being realized with all indigenously developed elements except Rubidium Source.

RESPOND



RESPOND at SAC is implemented under the umbrella of ISRO's RESPOND programme and caters to specific research topics pertaining to SAC activities related to payload development, data processing and applications in the areas of Satcom, Navigation and Remote Sensing. The RESPOND programme has been running at SAC with the continuous research support of academic institutes and universities located in different states of India. The esteemed institutions/ universities like NITs, NIAS, CEPT University, DA-IICT, IITs, Nirma University *etc.*, participate in the RESPOND programme at SAC. The programme at SAC has evolved into a dynamic & responsive face of RESPOND and contributes significantly to ISRO's programme on Sponsored Research. The details on 41 approved ongoing Research projects as on March 31, 2013 is given in Column chart and table.

Sr. No	Research Title	Name of University
1.	Study and Optimization of Microstrip Antenna System to receive satellite link from moving trains	Jadavpur University, Kolkata
2.	Morphodynamic study of the Digha coast of West Bengal for sustainable development and erosion mitigation using remote sensing and GIS techniques	Indian Institute of Technology, Kharagpur
3.	Active vibration control of laminated shells	Indian Institute of Technology, Roorkee
4.	Morpho-tectonic evaluation of the KOSI river basin, Bihar using remote sensing data	Patna Science College, Patna University, Patna
5.	Analysis and development of Matched Feed for offset parabolic antenna system	Indian Institute of Technology, Guwahati
6.	Information extraction from multi-polar radar data	Indian Institute of Technology, Guwahati
7.	Study of Radar Bright Band height	Sona College of Technology, Salem
8.	Modeling of Rain Drop-Size Distribution and Attenuation at SHF/EHF Band for Indian Regions	Graphic Era University (Deemed University), Dehradun
9.	Predicting Flood Inundation using Remote Sensing & GIS Techniques : A case Study of North Bengal	University of North Bengal, Dist. Darjeeling, West Bengal
10.	Designing of SLMs based on Nematic Liquid Crystals Doped with non-mesogenic molecules (Polymer, Nano-Particle and Dyes)	University of Lucknow, Lucknow
11.	Design and development of a miniaturized Dual-Band / Tri-Band antenna using Negative Refraction Index technique	Charotar Institute of Technology-Changa, At & Po : CHANGA, Ta. Petlad, Dist. Anand,
12.	Development of advanced nano ZnO sensors for Atmospheric and Environmental monitoring	University Science College, Tumkur University, Tumkur
13.	Satellite based assessment of fire severity and validation in Uttarakhand	Forest Research Institute,P.O. New Forest, Dehradun
14.	Design & Demonstration of a set of algorithm for High Reliability Wireless Data Acquisition & Control	Shri Mata Vaishno Devi University, Jammu

Sr. No	Research Title	Name of University
15.	Development of advanced Fractional Transform based algorithm for Satellite Image Compression, Encryption, Digital watermarking and Image Matching Applications	Thapar University, Patiala
16.	CDMA code design, Link-level simulation, and Interference analysis for IRNSS-based SatNav receivers	PES Institute of Technology, Bangalore
17.	Design and Analysis of Frequency Selective Surface at Ka/Ku Band for Reflection and S Band for Transmission	Jaypee University of Information Technology, Waknaghat,Dist. Solan (HP)
18.	Implications of Satellite Imagery on Cultural Heritage Resource Management	National Institute of Advanced Studies (NIAS), Bangalore
19.	Design, Development and Hardware implementation of BPSK, QPSK and other modulation schemes as part of Software Defined Radio (SDR)/Cognitive Radio (CR), for use in Satcom terminals	Dhirubhai Ambani Institute of Information and Communication Technology (DA-IICT), Gandhinagar (Gujarat)
20.	High resolution Indian Ocean State estimation	University of Allahabad, Allahabad
21.	GIS based Early warning landslide susceptibility model using data mining classification approach	VIT University, Vellore, Katpadi-Thiruvalam
22.	Feasibility studies on enhancing detector efficiency with structured plasmonic films	Indian Institute of Technology, Kanpur
23.	Dual Blind Detection Robust watermarking for Multimedia security	Sri Venkateswara College of Engineering, Sriperumbudur, Tamilnadu
24.	Dimensionality reduction of Hyper-spectral remote sensing data	Indian Institute of Technology, Roorkee,
25.	Simulation and analysis of system design requirements for ground to satellite and inter satellite free space optical communication link	Indian Institute of Technology, Hauz Khas, New Delhi
26.	Development of Approaches for Geometric, Radiometric and Atmospheric Correction of Remote Sensing Data Products for Multidate Data Analysis	VIT University, Vellore, Katpadi-Thiruvalam
27.	Grid based application development for satellite images processing	VIT University, Vellore
28.	3D reconstruction and software development for city model generation from satellite images	Indian Institute of Technology, Roorkee

Sr. No	Research Title	Name of University
29.	Wavelet based image compression / decompression with pipelined architecture on FPGA	Kumaraguru College of Technology, Coimbatore
30.	Design and simulation of a new Energy Efficient ML-MAC Wireless Sensor Protocol	Mody Institute of Technology and Science, Lakshmangarh
31.	Analysis of Dielectric Resonator Antenna Array	National Institute of Technology, Rourkela
32.	VHDL Implementation of Efficient Trelli's coded spatial modulation scheme for MIMO communication	S.A. Engineering College, Thiruverkadu-Post (Chennai)
33.	Conformal Array synthesis using evolutionary algorithms for the generation of a Shape Beam Antenna for Data Transmission	National Institute of Technology, Rourkela
34.	Robust Video Streaming using H.264 Scalable Video Coding over Mobile Broadband Networks	Sri Venakteswara College of Engineering,Pennalur, Sriperumbudur
35.	Design and development of Low insertion loss narrow band Surface Acoustic Wave (SAW) Filters on Quartz substrate at VHF & UHF for satellite communication	Indian Institute of Technology-Delhi, Hauz-Khas, New Delhi
36.	Feasibility studies on development of surface integrity and strength characteristics of rapid prototyped components to enable their direct application in design and development activities of payload for spacecraft	Jain University, Jakkasandra Post, Kanakapura Taluk, Ramnagaram (Bangalore)
37.	Study of pollution mechanisms in Urban aquifers of Bruhat Bengaluru Mahanagara Palike (BBMP) area by integrated Geophysical, Remote Sensing and GIS techniques	Dayananda Sagar College of Engineering, Bangalore
38.	Ontology-based semantic annotation generation and retrieval of images using multiple sub ontologies	Adhiyamaan College of Engineering and Research Institute, Hosur, Krishnagiri District, Tamilnadu
39.	Assessment of the Zooplankton community structure and secondary productivity in the Chennai and Portonovo, Northern coast of Tamilnadu	Annamalai University, Parangipettai
40.	Wave modelling for North Indian Ocean using SAR and MIKE-21	Anna University, Chennai
41.	Development of III-Nitrides thin film(s) for high frequency SAW device applications	Indian Institute of Technology Rajasthan, Jodhpur

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Management Support Activities

Throughout the year a large number of backbone activities take place in the Managerial systems which make the environments conducive for the realization of Research, development & project activities in the Centre. These activities are channelized through Projects & Planning Group.

Projects and Progress Monitoring

Progress monitoring of various ongoing projects in the Centre, independently and through various committees, assessing and coordinating the resource requirements, identifying critical areas and generating follow-up action items are crucial activities to keep the projects on track. In order to evolve an effective Project Monitoring mechanism in the centre, a compilation of the scheduled activities and sub-tasks of all the projects and TDP activities of the centre are carried out. Monthly progress & status of the Centre is generated every month from the inputs of the Divisions/Groups and Areas in the Centre and a highlight of the activities is sent to Head quarters. An Archival of the monthly progress reported by various division, groups and areas is being maintained.

In order to have comprehensive and independent project monitoring a Collaborative Intra centre Review Mechanism is implemented through committees as mentioned below;

1. Communication & Navigation Systems Monitoring and Review Committee (CNMRC)
2. Remote Sensing Sensors Monitoring & Review Committee (RMRC)
3. Applications Projects - Monitoring and Review Committee

These Committees are responsible for monitoring the status and progress of on-going activities/projects in the respective areas and helping the project functionaries. They enable inter-entity coordination and help to identify the critical areas of the project.

A detailed compilation of the centre's activities was carried out and the Annual Report of the Centre for the year 2011 – 2012 was generated. Periodical reviews of several ongoing projects by Director, SAC were arranged. Problem areas were highlighted during the review and action items generated were followed for timely resolutions.

Results Framework Document (RFD)

RFD is an important tool for the monitoring and evaluation of the various on-going activities/projects in the centre. The Prime Minister approved the outline of a 'Performance Monitoring & Evaluation System (PMES)' for Govt. Departments. Under PMES each department is required to prepare a Result-Framework Document (RFD). RFD provides a summary of the most important results that a dept/ministry expects to achieve during the financial year. The main purpose is to provide an objective & fair basis to evaluate department's overall performance at the end of the year. 24 activities were completed out of 28 identified activities and score of 9.42 pts out of 11.1 pts was achieved for the year 2012-13.

RESPOND Coordination

During the year, special efforts were made towards increasing the participation of institutions from various regions of the country by organizing interest exploration meetings. As of now there are 41 approved ongoing projects and another 51 project proposals are in the process of approval. Annual Respond Review held at SAC during November 1-2, 2012, 44 Principal investigators/representatives from academic institutes & universities had participated. Thirty (30) ongoing projects & fourteen (14) new project proposals were reviewed. An Interest Exploration meeting of 'RESPOND at SAC' was held at Aizawl-Mizoram wherein 49 short proposals were received and 7 proposals are in process of approval.

Budget Planning & Monitoring

Overall budget of the Centre is monitored through regular expenditure reviews to realise the targeted spending. Centre budget expenditure was depicting the smooth and well planned operation of the centre where spending of the total annual budget was 26.08 % in first quarter, 23.53 % in second quarter 21.39 % in third quarter, and 28.94 % in fourth quarter.

HRD Activities

A comprehensive training plan is implemented at SAC & DECU. The objective is to provide an opportunity through a series of Multi-tier Training Modules to all levels of staff (both S&T and Administration.). Atleast one training programme/seminar needs to be attended in order to meet both personal and organizational goal within three years. Various programmes have been organized and about 450 deputed to various Conferences/Seminar in India. The nature of programme includes both high-end technical course (like DSP, Embedded Systems, Lab-view, Reliability Engineering, et al) and general programmes (like First Aid, Internet Security, Efficient Secretary etc.). Under ISRO T&D Program- 3 STP (Structural Training Program) and1 EDP (Executive Development Program) organised for 123 participants. While under SAC/DECU T&D program- 19 programs/workshops and 23 lectures were organized in this year.

Capacity Building

SAC is actively involved in imparting training to scientists and engineers from the Asia Pacific region through the nine months PG diploma programs of the CSSTEAP. The Valedictory function of SATCOM-8 Course of CSSTEAP was organised at SAC on April 30, 2012. Dr. T. K. Alex, Director, ISAC presided over the function. Training on 'Hi-Rel electronics fabrication and packaging assembly' for Industry personals organized at SAC on July 9-25, 2012. Fifteen participants (13 from industries & 2 from SAC) attended the training.

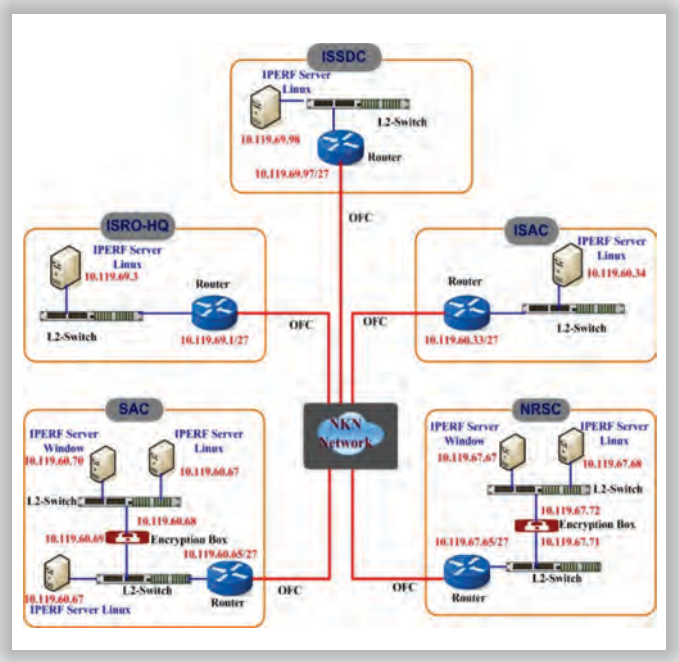
IPR & TT

Technology Transfer Agreement for 'Multilayer Printed Antenna' was signed on April 16, 2012 with Astra Microwave Products Ltd, Hyderabad. Technology Transfer agreement for indigenous GIS software was renewed on August 17, 2012.

Three cases (Unified Horn Antenna, MMIC True Time Delay Phase Shifter) in patents/copyright were originated and are in different stages of filing. Currently 7 Technology Transfer proposals are submitted to ISRO HQ for approval and 3 Technology Transfer cases in pipeline. SAC and TIFAC organised a Seminar on IPR at SAC in December 2012.

Network & Information Services

Realising the potential of IT for improving the overall organizational efficiency the Network based services have been used very effectively for exchange of data, information, documents and for overall communications amongst various entities of SAC. SAC has taken lead role in using NKN for Inter centre data communication. 21 DOS/ISRO locations are now part of ISRO-DOS NKN VRF. Thorough Bandwidth performance evaluation between SAC and ISSDC, ISTRAC, ISAC, NRSC, ISRO HQ and PRL is carried out. Secure data communication performance evaluation between SAC & NRSC and SAC & ISTRAC using ADRIN encryption box has been carried out. VEDANSH-NT is operationalized at 14 DOS/ ISRO centres and VEDANSH-T is being used at SAC, SCL and LPSC.



Web based lunch booking portal "AKSHAYPATRA" was released in June 2012.

Outreach

Space Exhibition (VSSE)

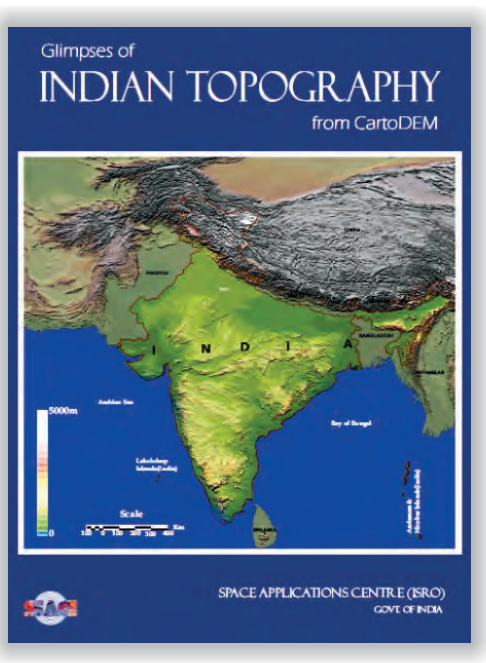
10 exhibitions arranged at various locations in Gujarat, Goa and Rajasthan. Mars payload subsystems, Atomic clock, Nano payload and RISAT modules displayed on special events. National Science Day (Feb. 28), National Technology Day (May 11) & World Space Week (October 4-10) were celebrated. VSSE also participated in World Meteorology Day celebration at Gujarat Science City on 23rd March. To further improve the outreach efforts a new exhibition building civil work has been initiated.

House Journal SAC Courier

SAC Courier is the flagship journal of the centre and plays vital role in the outreach activities. Wherein holistic way centre activities are covered and presented in a lucid manner. It is reaching to all DOS/ISRO locations and various reputed educational institutes across the country. Special issue (March 2013) of SAC Courier was released to commemorate the 25 years of Indian Remote Sensing.

Atlases

Lunar Atlas was generated using Chandrayaan-1 TMC data and using Cartosat-1 DEM "Glimpses of Indian Topography" was released during the year.



Library

During the year 2012-13, SAC library procured, technically processed and displayed about 380 books/monographs related to core area and 579 other types of documents which include technical reports, standards & specifications, Hindi books and other miscellaneous documents.

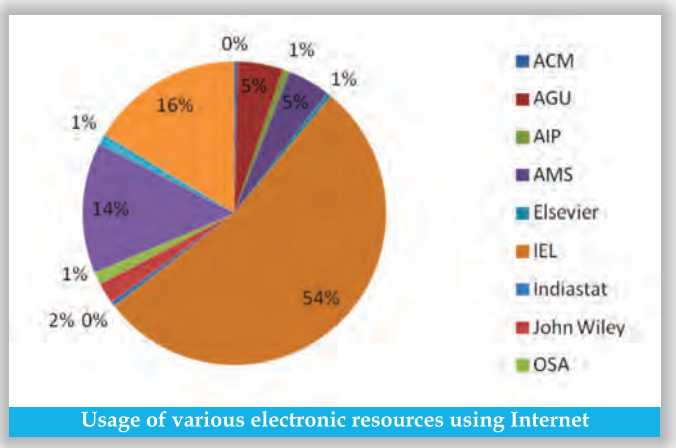
Library subscribes to 465 printed journals and about 450 e-journals, and during the period 3637 loose issues were registered, processed and made available to users for reference. Full text access to electronic journals is possible using internet from SAC main, Bopal as well as DES Campuses. Printed journals were regularly scanned and entries of 619 relevant articles were made to article database in Libsys.

The digital repository of library provides access to various resources in digital form. During the year, library added number of e-books, e-reports and papers of SAC scientists, published in various journals, thesis and e-issues of In House publications such as "SAC Courier" and Hindi magazine "Abhivyakti" in the repository. Various CD's and DVD's acquired by the library are regularly mirrored on the NAS. The users are able to access the electronic documents over the network. This year 359 CD/DVDs were added to this collection.

This year library extended 331 temporary (Student Trainees, Apprentices, JRFs etc) and regular memberships. Total approx 10773 check-outs and 10675 check-ins, and 1020 reservations of physical documents were carried during the year.

On various occasions such as Hindi Mah, World Space Week, during seminar on VLSI, and on Health and Aarogya, SAC library organised four thematic Book Exhibitions along with 2 book displays of technical books, received "on approval" from vendors.

Adequate support has been redered by reprographic facility of SAC Library in documentation. Approx. 3, 55,500 pages in B/W and 2, 18, 900 pages in colour were printed and approx 4,800 documents were bounded in-house.



Usage of various electronic resources using Internet

हिन्दी

वर्ष 2012–13 के दौरान सैक, अहमदावाद की उपलब्धियां एवं विशेष कार्य

नराकास से पुरस्कार

प्रथम पुरस्कार के रूप में प्रदत्त शील्ड

अंतरिक्ष उपयोग केंद्र को अहमदाबाद नगर में केंद्रीय कार्यालयों की श्रेणी में वर्ष 2013–2012 के दौरान सर्वश्रेष्ठ राजभाषा कार्यान्वयन हेतु नगर राजभाषा कार्यान्वयन समिति, अमहदाबाद की ओर से प्रथम पुरस्कार प्रदान किया गया । श्री राजेश खंडेलवाल, ग्रुप प्रधान, पीपीजी ने प्रथम पुरस्कार के रूप में शील्ड व प्रमाणपत्र ग्रहण किया । अधिकारी श्री बी. आर. राजपूत, वरिष्ठ हिन्दी को भी सैक में राजभाषा के सफल कार्यान्वयन के उपलक्ष्य में प्रशस्ति–पत्र प्रदान कर सम्मानित किया गया ।

तकनीकी हिन्दी संगोष्ठी

अंतरिक्ष उपयोग केन्द्र, अहमदाबाद में दिनांक 27.06.2012 को श्री वी. एस. पलसुले, निदेशक, डेकू की अध्यक्षता में ''भारतीय अंतररिक्ष कार्यक्रम में स्वदेशी उद्योगों एवं संस्थाओं का योगदान'' विषय पर एकदिवसीय हिन्दी तकनीकी संगोष्ठी का आयोजन किया गया ।डॉ. रत्नेश्वर झा, डीन, प्लजमा अनुसंधान संस्थान (आईपीआर), गाँधीनगर मुख्य अतिथि के रूप में उपस्थित रहे ।मुख्य अतिथि के कर–कमलों से संगोष्ठी लेख–संग्रह तथा निदेशक, डेकू द्वारा लेखसंग्रह सीडी का विमोचन भी किया गया ।तीन सत्रों में 30 आलेखों की पावर पाइंट प्रस्तुति की गई ।तीन श्रेष्ठ प्रस्तुतियों के लिए निम्नानुसार प्रथम, द्वितीय और तृतीय पुरस्कारों की घोषणा की गई ।

हिन्दी माह 2012

सैक/डेकू में दिनांक 01 सितंबर 2012 से 30 सितंबर 2012 तक हिंदी माह का आयोजन बड़े हर्षोल्लास के साथ किया ।डॉ. अंजना अरगडे, विभागाध्यक्ष, हिंदी विभाग, गुजरात विश्वविद्यालय, अहमदाबाद मुख्य अतिथि के रूप में उपस्थित रहीं । हिंदी माह के उद्घाटन समारोह के बाद श्री पलसुले जी ने सैक पुस्तकालय में हिंदी पुस्तक प्रदर्शनी का उद्घाटन किया ।माह के दौरान आयोजित हिंदी तथा हिंदीतर भाषा वर्गों के लिए आयोजित विभिन्न 12 हिंदी प्रतियोगिताओं में केंद्र के 1000 से भी अधिक स्टाफ सदस्यों ने भाग लिया और साथ ही इस वर्ष पहली बार कर्मचारियों के परिवार के सदस्यों (विवाहितों और बच्चों) के लिए भी 05 हिंदी प्रतियोगिताओं का आयोजन किया गया, जिनमें सभीने पूरे उत्साह से भाग लिया ।

विश्व हिंदी दिवस

अंतरिक्ष उपयोग केंद्र तथा विकास एवं शैक्षिक संचार युनिट (डेकू), अहमदाबाद में 10 जनवरी 2013 को विश्व हिंदी दिवस मनाया गया । इस अवसर पर सैक तथा डेकू के कर्मचारियों के लिए एक दिवसीय राजभाषा कार्यशाला का आयोजन किया गया । कार्यक्रम की अध्यक्षता श्री राजेश खंडेलवाल, ग्रुप प्रधान, पीपीजी, डेकू ने की और उनके साथ श्री वी. दत्त, सेवानिवृत हिंदी अधिकारी–II, सैक और श्रीमती नीलू सेठ, हिंदी अधिकारी, सैक भी मंच पर आसीन थे । सैक एवं डेकू में विश्व हिंदी दिवस के उपलक्ष्य में प्रभाग स्तर पर हिंदी में विशेष कार्य करने के संबंध में नियंत्रक, सैक द्वारा एक परिपत्र भी जारी किया गया ।

राजभाषा कार्यशाला

23 फरवरी, 2012 को केंद्र में वैज्ञा./अभि. एसएफ वर्ग के 84 वैज्ञानिक/अभियंताओं (प्रथम बैच), 04.05.2012 को 63 वैज्ञानिक/अभियंता–एसएफ (द्वितीय बैच), 07.08.2012 को प्रशासनिक वर्ग के 39 वरि. वै. सचिव, परि. वैयक्तिक सचिव, वैयक्तिक सचिव एवं वैयक्तिक सहायको तथा 10.01.2013 को वरिष्ठ सहायकों के लिए एक दिवसीय राजभाषा कार्यशालाओं का आयोजन किया गया ।

अन्य विशेष कार्य

- ''आरआईसैट–1 : समकक्षों में प्रथम'' नामक वृत्तचित्र का हिंदी संस्करण तैयार किया गया । इस वृत्तचित्र का दूरदर्शन न्यूज चैनल तथा लोकसभा टीवी प्रसारण किया गया ।
- सेमी कंडक्टर लेब, चंडीगढ़ में आयोजित 27 अप्रैल 2012 को संपन्न अंतर केंद्र हिंदी तकनीकी संगोष्ठी में श्री कमलेश कुमार बराया, वैज्ञा./अभि–एसई को श्रेष्ठ प्रस्तुतीकरण के लिए द्वितीय पुरस्कार प्रदान किया गया ।
- दिनांक 21 सितम्बर, 2012 को सैक व्याख्यान माला के तहत राष्ट्र निर्माण में डॉ. बी. आर. अंबेडकर साहब का योगदान के उपलक्ष्य में श्री जागीश सोमकुंवर, सुपरिटेंडेंट अभियंता, ओएनजीसी ने व्याख्यान दिया ।
- केंद्र में 29 से 30 नवंबर 2012 के दौरान आयोजित सतर्कता जागरूकता सप्ताह के दौरान हिंदी में निबंध एवं वादविवाद प्रतियोगिताओं का आयोजन किया गया ।
- 4 मार्च, 2013 से 10 मार्च, 2013 तक केंद्र में राष्ट्रीय सुरक्षा सप्ताह मनाया गया । इस दौरान स्टाफ सदस्यों के लिए हिंदी/गुजराती/अंग्रेजी निबंध लेखन एवं मात्र हिंदी में हिंदी वक्तृता प्रतियोगिता आयोजित की गई ।

17 सितंबर 2012 को अंतरिक्ष उपयोग केंद्र (सैक) के विक्रम हॉल में हिंदी माह पुरस्कार वितरण समारोह का आयोजन किया गया । कार्यक्रम की अध्यक्षता श्री आ.सी. किरण कुमार, निदेशक, सैक ने सैक लाइब्रेरी की वेबसाइट की हिंदी संस्करण का विमोचन किया ।

Administrative and Auxiliary Activities

Finance & Accounts:

Finance & Accounts Division at SAC is responsible for the maintenance of accounting system as per Departmentalisation of Accounts and meeting expenditure & commitment over budget allocations with respect to Centre & Projects. During the Financial Year 2012-13, Rs.570 Crores expenditure and Rs.515 Crores cash flow were recorded under PAO, SAC.

Total numbers of claims handled under different categories are as mentioned below;

Sr. No.	Nature of Claims	Numbers
1.	CHSS (Employees, retired employees, Hospital, Honorarium to Doctors, CISF)	62,000
2.	TA , LTC , FTA	9,700
3.	Foreign Bills	5,360
4.	Local Suppliers Bills & Miscellaneous Bills, Contingency, Imprest	12,600
5.	CMD Bills	1,629
6.	PF, Loans, Advances	1,490
7.	Pre- Audit	2,150
8.	a) Pension, Gratuity, Commutation, Family Pension and Revision of Pension, E.L./HPL encashment. b) Arrears of Pension for MACP and one increment cases	580 180
9.	Payment of CGEGIS	120
	Total	**95,809**

Administration & Establishment

During the year 88 new recruitments have taken place in the centre. At the same time 69 staff members have superannuated and 16 other members have opted for VRS/Resignation during the year. Total Staff strength on March 31, 2013 was 1836.

PURCHASE AND STORES

Purchase and Stores division has the responsibility to process procurements for various facilities, R&D and Project activities in the Centre. Safe custody of the materials received, distribution of stock items such as stationery etc., disposal of surplus and condemned items etc.
Summary of Activities is as follows:

PURCHASE

- No. of Indents : 2466 worth Rs. 297.78 crores were registered and processed.
- No. of purchase orders : 2456 Purchase Orders placed to the tune of Rs.371.33 crores.

STORES

- No of Consignments received- 3109
- No of MIRV raised - 3038

Major Civil Works

A number of activities are going on for civil works. Efforts are made to use renewable energy resources. In this direction, two 10 kW "GRID connected solar power plants" were installed and commissioned on May 24, 2012.

Construction of Horizontal Extension of canteen building at Technical area, New SAC Campus, Bopal, Ahmedabad – Extension of Dining hall, kitchen and service areas to enhance the seating capacity from 80 persons to 180 persons. Total Cost of the project at the completion was Rs 63.20 Lakhs and Plinth Area is 216 sq.m. Some of the Special features viz., false ceiling designed in harmony with flooring pattern & fusion of Existing facility and new facility are carried out to evolve a new ambiance.

Improved Housing norms were implemented in D- Type & E- Type quarters of Vikramnagar Colony.

Civil work Activities at SAC Campus, Bopal

Completed works

- Environmental clearance received from State Environmental Impact Assessment committee. Master plan of new campus was prepared and presented to competent authority.
- Works of Compound wall, Gate & bore well was completed.
- 66/11 KV over head HT lines have been converted into under ground Cables.
- CAL VAL site including equipment store room has been completed.

Works in progress

- Phase-1 Infrastructure work, which includes part of sub-base for main road inside campus, patrolling pathways, security cabins at main gate is in progress.
- Payload integration and checkout facility building including Electrical substation and AC plant room is in Tendering stage.

Other Activities

- Fire Safety week was observed in SAC from April 14-20, 2012. The agenda of the programme was "Smoke management saves lives".

- The 66th Independence Day was celebrated in SAC and Director, SAC unfurled the National Flag.

- In order to celebrate completion of ISRO's first dedicated geostationary meteorological satellite KALPANA (METSAT)'s decade of successful service to the Nation, a workshop was jointly organised by IMS-AC, ISRS-AC, SSME, INCA-GB and ISG-AC.

- SAC observed 'Vigilance Awareness Week' during October 29, 2012 to November 03, 2012. The focus was on 'Transparency in Public Procurement'.

- A two-day ISRO Colloquium on Software Quality ICSQ-2012 was organised at SAC during Nov. 22-23, 2012. A total of 210 delegates participated in this event, out of which 58 were from different ISRO centres and 14 experts from academia, software industry and government. The event was inaugurated by Shri S. Selvaraju, Sr. Advisor, DSRQ, ISRO HQ.

- 64th Republic Day was celebrated in SAC campus, Director, SAC unfurled the National Flag. The meritorious students of SAC & DECU community who had topped in X & XII Board exams were awarded by Director, SAC.

- 6th GEOSS Asia Pacific Symposium was held at Ahmedabad during February 25-27, 2013

- A blood donation camp was organized at SAC on March 22, 2013. Record collection of 177 units was donated to Red-Cross.

- National Safety week was celebrated in SAC from March 4-10, 2013. Many competitions, in the field of safety were conducted during the celebrations. Two lectures were delivered: (i) "Stress to De-stress (A simple journey)" by Dr Sangita Dagia, Clinical Psychologist; (ii) "3 Cs for Cancer: Check, Control & Conquer" by Dr. Sheroo Zamindar, Apollo hospital, on 08 March 2013 (Women's day).

Awards & Honours

Dr. J. S. Parihar	ISRO Performance Excellence Award 2010
Shri. R. K. Dave	ISRO Performance Excellence Award 2011
Shri. Arup Roy Chowdhury	ISRO Merit Award 2010
Shri. D. K. Das	ISRO Merit Award 2010
Shri. Nilesh M. Desai	ISRO Merit Award 2010
Shri. Santanu Chowdhury	ISRO Merit Award 2011
Dr. (Mrs.) Sushma Panigrahy	ISRO Merit Award 2011
Shri. Maulik L. Bhavsar	ISRO Young Scientist Merit Award 2010
Shri. Pankaj Kanti Nath	ISRO Young Scientist Merit Award 2010
Shri. Ritesh Kumar Sharma	ISRO Young Scientist Merit Award 2010
Shri. Vishnukumar D. Patel	ISRO Young Scientist Merit Award 2010
Shri Himanshu N. Patel	ISRO Young Scientist Merit Award 2011
Smt. Shalini Ujjwal Gangele	ISRO Young Scientist Merit Award 2011
Shri. H R Kansara	ISRO Team Excellence Award 2010
Shri. H C Sanandiya	ISRO Team Excellence Award 2010
Shri. J R Joshi	ISRO Team Excellence Award 2010
Shri. D. B. Dave	ISRO Team Excellence Award 2011
Dr. Pradip K Pal	ISRO Team Excellence Award 2011
Shri. N. Y. Pandya	ISRO Team Excellence Award 2011
Shri. Nitin Khanna	ISRO Team Excellence Award 2011
Shri. Prantik Chakraborty	ISRO Team Excellence Award 2011
Smt. Priyanka Gupta	ISRO Team Excellence Award 2011
Ms. Sumitra Behera	ISRO Team Excellence Award 2011
Shri. M. S. Ghoghra	ISRO Team Excellence Award 2011
Shri. Mukesh Patel	ISRO Team Excellence Award 2011
Smt. Bhavika Patel	ISRO Team Excellence Award 2011
Shri Rajendra Singh	ISRO Team Excellence Award 2011
Shri Vijay N. Panchal	ISRO Team Excellence Award 2011
Shri J. G. Vachhani	ISRO Team Excellence Award 2011
Smt. Amita A. Shah	ISRO Team Excellence Award 2011
Shri. V. VishwanathanVedam	ISRO Team Excellence Award 2011
Shri. Rahul Dhingani	ISRO Team Excellence Award 2011
Shri. Madhav Das	ISRO Team Excellence Award 2011
Shri. K. R. Dave	ISRO Team Excellence Award 2011
Shri. MPT Chamy	ISRO Team Excellence Award 2011
Dr. Dinesh Kumar Jain	ISRO Team Excellence Award 2011
Shri. Raghav Mehra	ISRO Team Excellence Award 2011
Ms. Arpita Gajaria	ISRO Team Excellence Award 2011
Ms. Anuja Sharma	ISRO Team Excellence Award 2011
Dr. R M Gairola	ISRO Team Excellence Award 2011
Dr. A K Varma	ISRO Team Excellence Award 2011
Dr. V Sathiyamoorthy	ISRO Team Excellence Award 2011

Dr. Bipasha P Shukla	ISRO Team Excellence Award 2011
Shri.Rishi K Gangwar	ISRO Team Excellence Award 2011
Shri. C Mahesh	ISRO Team Excellence Award 2011
Dr. AK Shukla	ISRO Team Excellence Award 2011
Dr. Kaushik Gopalan	ISRO Team Excellence Award 2011
Dr. Prashant Kumar	ISRO Team Excellence Award 2011
Shri. AbhishekChakrabarty	ISRO Team Excellence Award 2011
Shri. Danish Hussain	ISRO Team Excellence Award 2011
Dr.Sasmita Chaurasia	ISRO Team Excellence Award 2011
Ms. Shivani Shah	ISRO Team Excellence Award 2011
Ms. Pushpalata Shah	ISRO Team Excellence Award 2011
Shri. B.B. Vasava	ISRO Team Excellence Award 2011
Shri. M.K. Patel	ISRO Team Excellence Award 2011
Shri. SK Parmar	ISRO Team Excellence Award 2011
Shri. B.H. Manglani	ISRO Team Excellence Award 2011
Shri. P.U. Adroja	ISRO Team Excellence Award 2011
Shri. Satish Kumar Pandey	ISRO Team Excellence Award 2011
Shri. Rajeev Jyoti	ISRO Team Excellence Award 2010
Shri. K.K. Sood	ISRO Team Excellence Award 2010
Shri. Y.H. Trivedi	ISRO Team Excellence Award 2010
Shri. A.C. Mathur	ISRO Team Excellence Award 2010
Shri. Jigar Pandya	ISRO Team Excellence Award 2010
Shri. Jidesh	ISRO Team Excellence Award 2010
Shri. K.P. Raja	ISRO Team Excellence Award 2010
Shri. C.R. Macwan	ISRO Team Excellence Award 2010
Shri. H.C. Sanandiya	ISRO Team Excellence Award 2010
Shri. Sagi Sravan Kumar	ISRO Team Excellence Award 2010
Shri. B. N. Pandya	ISRO Team Excellence Award 2010
Shri. S. M. Chauhan	ISRO Team Excellence Award 2010
Shri. P. K. Panchal	ISRO Team Excellence Award 2010
Shri.Ashokkumar N Vaghela	ISRO Team Excellence Award 2010
Shri. Sherin Bhargavan	ISRO Team Excellence Award 2010
Shri. D Subrahmanyam	ISRO Team Excellence Award 2010
Shri. Arup Kumar Hait	ISRO Team Excellence Award 2010
Shri. S S Sarkar	ISRO Team Excellence Award 2010
Shri. Sanjeev Mehta	ISRO Team Excellence Award 2010
Dr. Ratan Singh Bisht	ISRO Team Excellence Award 2010
Mrs. N K Mangalwedhekar	ISRO Team Excellence Award 2010
Dr. Amiya Biswas	ISRO Team Excellence Award 2010
Shri. Pradipsingh B Thakur	ISRO Team Excellence Award 2010
Shri. Hanuman Prasad	ISRO Team Excellence Award 2010
Shri. Manoj Detroja	ISRO Team Excellence Award 2010
Mrs. Kuhelika Bera	ISRO Team Excellence Award 2010
Shri M A Chauhan	ISRO Team Excellence Award 2010
Dr. K R Murali	ISRO Team Excellence Award 2010
Shri. Harish Seth	ISRO Team Excellence Award 2010
Shri. Neeraj Dube	ISRO Team Excellence Award 2010
Shri. Saiyed M Rafik A Karim	ISRO Team Excellence Award 2010

Shri. Hitesh A Patel	ISRO Team Excellence Award 2010
Shri. Anil Sukheja	ISRO Team Excellence Award 2010
Shri. Satish Rao	ISRO Team Excellence Award 2010
Shri. A T Parmar	ISRO Team Excellence Award 2010
Shri. Surinder Singh	ISRO Team Excellence Award 2011
Shri. R S Sharma	ISRO Team Excellence Award 2011
Shri. A V Pathak	ISRO Team Excellence Award 2011
Shri. P C Mehta	ISRO Team Excellence Award 2011
Shri. Sharad Shukla	ISRO Team Excellence Award 2011
Shri. Dinesh Kumar Agrawal	ISRO Team Excellence Award 2011
Smt. Pravina Bhatt	ISRO Team Excellence Award 2011
Shri. Hemraj Singh	ISRO Team Excellence Award 2011
Shri. Tushar Gajjar	ISRO Team Excellence Award 2011
Shri. Ravi Ramarao	ISRO Team Excellence Award 2011
Shri. K C Bhagat	ISRO Team Excellence Award 2011
Shri. R P Singh	ISRO Team Excellence Award 2011
Shri. Y H Dave	ISRO Team Excellence Award 2011
Shri. Vikas Gupta	ISRO Team Excellence Award 2011
Shri. Kasif Khan A Pathan	ISRO Team Excellence Award 2011
Shri. Kirti Prakhar Srivastva	ISRO Team Excellence Award 2011
Shri. K F Patel	ISRO Team Excellence Award 2011
Shri. M C Gajjar	ISRO Team Excellence Award 2011
Shri. Vasant Patel	ISRO Team Excellence Award 2011
Shri. Pankaj S Parmar	ISRO Team Excellence Award 2011
Dr. J S Parihar	Rafi Ahmed Kidwai Award 2012
Shri. D K Das	ASI-ISRO Award 2010
Smt. Punam Pradeep Kumar	ASI - Woman Scientist – 2011
Smt. Shruti Sinha	IETE – Dr. Ranjana Pal Memorial Award – 2012
Ms. Puja Srivastava	IETE- Smt.Manorama Rathore Memorial Award- 2012
Mr. Naimesh Patel, Mr. A P Vora, Mr. C P Dewan Mr. Neeraj Mathur	ISAMPE Award
LRIT project	CSI Nihilent e-Governance appreciation Award
CISF SAC/PRL	2nd position (All India) "Best Unit Level Trophy"

Publications

During the year, SAC team has published a large number of technical reports, design documents, book chapters, books and papers. These documents are uploaded on VEDANSH- Technical repository which is a Hierarchical Digital Repository System that helps in archival and retrieval of documents in efficient and secure manner.

Overall, more than 400 papers, book chapters & papers in proceedings of Seminars/Symposium were published in this period. Publications in prestigious peered reviewed journals are listed below:

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2. Santhosh Kumar Ramagiri, Arvind B. Shukla, Ramaniklal B. Bavaria, Surinder Singh and Kaushik S. Parikh "Connector-less test setup for measurement of passive inter-modulation products at UHF band", International Journal of Microwave and Wireless Technologies.
3. Deepak Mishra, K. S. Dasgupta and S. Jit, "Hybrid Concatenated Convolutional Code for Deep Space Mission", International Journal of Computer Applications (IJCA), Volume 47– No.19, Sept 2012, pp. 33-38.
4. Chandra Prakash, Vijay Kumar Chakka, S N Satashia, K S Parikh "Digital Receiver based Ka Band Beacon Receiver for improved beacon power estimation" , IEEE International Conference on Communication and Signal Processing, April 3-5, 2013, India (ISBN: 978-1-4673-4866-9/13/$31.00 ©2013 IEEE)
5. Nehal A Ranabhatt, Sudhir Agarwal, Priyesh P Gandhi, 2013, "Design and Simulation of BPSK Demodulation at Low Bit Rate", International Journal of Engineering Research and Development, Volume 6, Issue 7, PP. 28-31
6. Nehal A Ranabhatt, Sudhir Agarwal, Priyesh P Gandhi, 2013, "RTL Design and Implementation of BPSK Modulation at Low Bit Rate", International Journal of Engineering Research & Technology (IJERT), Vol. 2 Issue 2
7. Nehal A Ranabhatt, Sudhir Agarwal, Priyesh P Gandhi, 2013, "Design and Implementation of Numerical Controlled Oscillator on FPGA", International Journal of Emerging Technology and Advanced Engineering, Volume 2, Issue 6
8. Tarulata H Chauhan, Sudhir Agarwal, Suchit Purohit, Amit Kumar, "Wireless Communications from High Altitude Platforms", International Journal of Emerging Technology and Advanced Engineering, Volume 2, Issue 6,
9. Tarulata H Chauhan, Sudhir Agarwal, 2013, "Implementation of High Seed Router", International Journal of Engineering Research and Technology, Vol. 1 (02), 2013, ISSN 2278 - 0181
10. Nehal A Ranabhatt, Sudhir Agarwal, 2013, "Low Bit Rate Design and Implementation of BPSK Demodulation on FPGA", International Journal of Modern Engineering Research (IJMER), Vol. 3, Issue. 3, May.-June. 2013 pp-1748-1755
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12. P K Gupta, R P Vaghela, K A Bhatt, S S Valdiya, "Two-Channel Monopulse Tracking Receiver for Onboard Antenna Tracking System", International Conference on Communication, Information and Computing Technology (lCCICT-2012), October 2012
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16. M. Senthil Kumar, C. S. Narayanamurthy and A. S. Kiran Kumar, Iterative method of baffle design for modified Ritchey–Chretien telescope,APPLIED OPTICS, Vol. 52, No. 6, February, 2013

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